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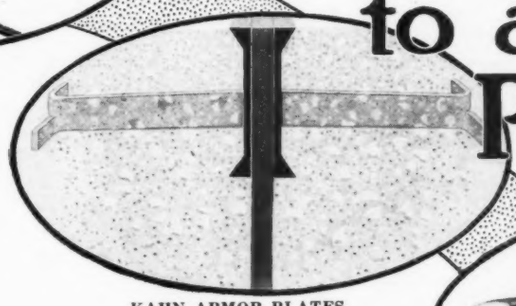

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REGULATING TRUCK WEIGHTS AND SIZES.

Last week the Pennsylvania state administration and the Motor Federation agreed on a bill that is expected to become a law at this session of the legislature. Fees are based on horse power. Motor vehicles (except fire apparatus) can not be more than 28 feet long or 90 inches wide, and the weight can not exceed 26,000 pounds except by special permit. Commercial vehicles weighing more than 3,000 pounds must contain the chassis, body and load weight painted on their sides in three-inch figures. Fifteen miles is the maximum speed for trucks up to 5,000 pounds; twelve miles for 8,000-pound vehicles; ten miles for 10,000-pound machines, and eight miles for all heavier trucks. Thirty miles is the maximum for other cars, except where local laws set a lower limit.

It will be remembered that the American Road Builders' Association last month adopted a resolution favoring 28,000 pounds as the limit of weight and 28 feet and 96 inches as the limit of size. It is unfortunate that a uniform standard cannot be adopted by all states, considering the great and increasing amount of interstate trucking that is taking place.

BUT HOW ABOUT THE BRIDGES?

What will happen when a 13-ton truck crosses a 6-ton bridge? While trucks of the former weight are to be permitted by the Pennsylvania law above referred to, the state highway department engineers have found numerous bridges on the important highways of the state that are not safe for more than six tons, and a considerable number that can not with safety be asked to carry more than three tons.

This inconsistency is by no means confined to Pennsylvania. We doubt whether there is a single state where conditions are much if any better. Many of them have passed laws limiting the weights of trucks to maximums that not a quarter of the bridges in the state can carry with safety. Some startling figures on this subject will be found elsewhere in this issue.

HUNDREDS OF MILLIONS FOR ROADS.

The most enthusiastic good roads advocate could hardly ask for more wholesale improvement of our highways than is in prospect for this year. In the majority of states the amount of such work done will be limited almost entirely by the amount that can be done and not by the money needed to pay for it. Four hundred million dollars has already been appropriated, and another hundred million, and possibly two hundred, will be available

by July; while other hundreds of millions are being arranged for to permit continuing the work next year. We refer now as casually to millions as we did to thousands a few years ago in speaking of road work.

What part of these millions each of the several states has available for this year's work is detailed in this issue. Only one state admits less than a million, and at least one or two count on more than twenty millions.

ARE OUR HIGHWAY BRIDGES SAFE?

County Highway Officials Say One-Third of All Bridges Are Unsafe for Heavy Trucks—A State Authority Says Eighty Per Cent.—Defective Bridges More Serious Than Defective Roadways.

Thirty per cent of the bridges on the county highways of the country are considered by the officials in charge of them to be unsafe for the heavier vehicles that are now using those highways.

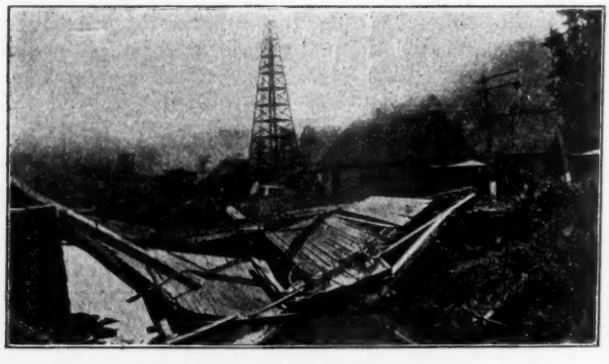
This is not a random statement or mere guess work. On another page in this issue will be found figures from county engineers or other county officials presenting their opinions as to the number of bridges in their respective counties that are unsafe for the traffic using their highways. These returns cover 33 states of the Union and the total number of bridges reported is about 75,000; and of those 75,000, about 22,500 are considered unsafe.

It will be noted that these figures are not those of alarmists or faddists, but are given by hundreds of county officials who are themselves in charge of the highways and bridges in question, and who would, it would seem, be more apt to underrate than to overrate the danger which these bridges present to the traveling public. The figures were given in reply to the question: "How many of your bridges do you consider unsafe for the heaviest traffic on your roads?" Six county officials said that none of their bridges were safe for such loads, while only 21 per cent claimed that all of their bridges were safe. Twenty per cent stated that 50 per cent or more of their bridges were unsafe, and 8 per cent admitted this concerning 75 per cent or more of their bridges.

A chain is as strong as its weakest link; and a highway system cannot safely carry vehicles any heavier than those that can use its weakest bridges.

Millions are being appropriated and spent for improved highways; and while, in a number of states, bridges are specifically mentioned as the subject for appropriations, in the majority of cases it is merely understood or implied that a part of the appropriation may be used for bridges, and in too many states bridges receive almost no benefit from the state or county appropriations.

Six, eight, ten and even fifteen-ton trucks are permitted on the highways of many states, and the roadway surfaces are being adapted to such loads; while on those same roads can be found bridges containing the sign "Not safe for loads of more than three tons," or possibly five tons, or in some cases less than three tons. When a ten-ton truck, finding roads suitable to carry it, reaches a bridges with such a sign, what is its driver expected to do? And what *does* he do? In some cases at least, rather than retrace his steps, he takes a chance. Results of such taking of chances are shown by illustrations on these pages. In some cases lives are lost, but in probably the majority the loss fortunately is confined to the truck, traction engine, road-roller or other heavy vehicle, and to the bridge floor or sometimes the entire bridge. Incidentally, the public which would otherwise continue to use this road suffers a loss, in that the bridge is impassable for weeks and possibly months, during which time either a considerable section of road is out of service except for purely local traffic, or teams must cross through the stream by detour.



WOODEN TRUSS BUCKLED.

In reply to a question submitted a few days ago to the State Highway Department of Pennsylvania, we received the information that "All bridges on the state's primary system for which the state is responsible are to be rebuilt. Department engineers, in their studies of interstate, canal and county bridges, have discovered numerous bridges the condition of which has been such that it has been necessary to post them, warning the public that they are not travelable with loads varying from three to six tons. Many important thoroughfares cross some of these structures."

STEEL TRUSS BUCKLED.

DEFECTIVE ROADWAY VS. DEFECTIVE BRIDGE.

When holes or other bad spots appear in a highway surface, they may be responsible for an occasional broken spring at the worst, while ordinarily they merely require a slowing up of traffic or possibly a short detour onto the shoulder. Occasionally insufficient width or a chuck-hole which requires a detour onto a soft earth shoulder results in a hold-up of a heavy truck until aid can be secured to draw it back onto the paved way. These are the results of insufficient width or strength or character of roadway pavement.

The result of insufficient width or strength of a highway bridge is much more serious, both to the vehicle which ultimately causes its partial or total destruction, and also to all traffic on the highway which is held up for days or weeks until repairs or a renewal of the bridge can be completed. The figure of speech

of the "weakest link" applies perfectly. The bridge is an essential part of the highway and the highway as a whole is not safe for any load that the bridge will not support in safety. With that link—the bridge—out of commission, the entire chain is useless except as its two short sections can be used independently.

WHICH IS WORSE FOR THE TRUCK AND WHICH FOR THE HIGHWAY?

A truck carrying acetylene tanks for government ship yards mired on a soft shoulder.

A thousand-gallon oil truck through the floor of an old county bridge.

Lack of strength is not the only dangerous element in a bridge. The wing-walls or other forms of protection to the abutments may be so inadequate that a freshet may undermine or destroy them; and no matter how strong the bridge, it can support no more than the abutments themselves will carry, and can of course support nothing with the abutments removed. That this is a real danger is indicated by some of the accompanying photographs showing that concrete bridges, steel bridges and masonry arches have all been known to fail because of the washing out of abutments. To prevent such an accident, it may be necessary to extend the investigation and the construction for a considerable distance above and below the bridge itself in order to provide against the erosive effects of freshets. In order to avoid the expense attendant upon the construction of a long bridge, the abutments in many cases are placed too close together, contracting the waterway; or in order to avoid too long or too steep approaches to the bridge, the bridge is placed too low and freshets, carrying logs, trees and other heavy and bulky articles, may sweep the bridge from its abutment.

It is evident that to be safe, a bridge must not only have sufficient strength in itself, but it must be of such length and so provided with abutments and approaches for the stream as to prevent its destruction by outside causes.

PRECAUTIONS THAT SHOULD BE TAKEN.

As to the bridge itself, the hundreds of accidents that have occurred indicate that the floor is usually the weakest point. In the majority of cases the vehicle that causes the damage breaks through the floor, leaving the trusses or girders comparatively uninjured. In hundreds of cases which probably are not entered on the records at all, the floor boards break at some knot or worn out or rotted point and the damage is limited to this. But it undoubtedly happens that in some cases, at least, the breaking of a floor board brings a jolt and strain upon the floor beams and other members of the floor system which causes them to give away, although they would have carried the load had not the floor boards broken. The moral of this seems to be that continuous attention should be paid to bridge floors, and the first sign of weakness should be remedied by replacing a worn or rotting plank or planks. The floor beams and other members are ordinarily more difficult to get at than the truss members, but require even more careful and frequent inspection and painting.

No argument would seem to be necessary to prove that, when a maximum limit of load is set for the highways of a state or county, any bridges on such highways that were designed for lighter loads should be replaced with heavier ones. Until they can be so replaced, warning notices stating the maximum safe loads that they can carry should be posted not only on the bridges themselves but also on the roads leading to the bridges; and penalties should be enforced upon such as disregard the notices.

Equally important is the periodic inspection of bridges by competent men and the immediate remedying of all defects found. All steel and iron work should be kept painted to prevent rust; and in doing this, the hidden floor beams and other parts of the floor system should not be overlooked. Before painting, all loose paint and scale should be thoroughly removed.

In the case of wooden bridges, the first indication of rotting at joints or bolt holes should lead to an immediate replacing of the decaying member; and decay at other points is only slightly less dangerous.

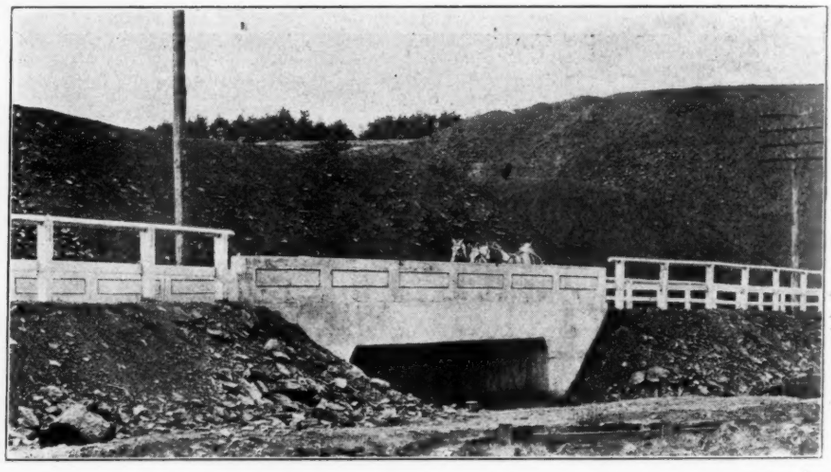
A rust hole or rot hole the size of a dime is as serious a matter in a bridge as a chuck-hole the size of a wagon is in a roadway. It requires more careful inspection to determine the former, and the necessity of such inspection should be continually emphasized in instructions to foremen and others in charge of highway maintenance.

One of the remarkable things about the situation is the considerable number of county officials who not

only keep no complete and up-to-date record of each bridge upon their county road systems, but do not even know exactly (some admit that they do not know even approximately) the number of bridges on the county roads under their supervision. Of highway features as important as bridges, there should be a record of every one; the plan of giving each bridge a number, which is adopted by some highway departments, being an excellent one. The record of each bridge should give the date when built and details as to its length, features of design, etc., and the live load for which it was calculated. There should be entered upon the record of each bridge the dates when it was inspected and the general tenor of each report as to whether the bridge was in good condition and for how heavy loads it may be considered safe; and the dates when the bridge was painted should be entered also. There should also be some systematic method for insuring that every bridge is inspected periodically, while special ticklers may be used for insuring a more frequent and thorough inspection of bridges concerning whose safety there is some question.

"LOOK ON THIS PICTURE, THEN ON THAT."

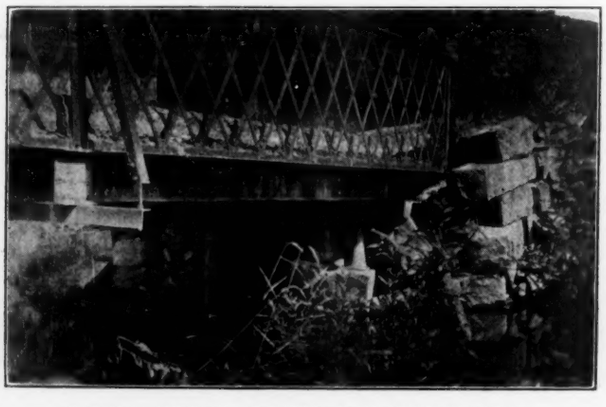
Both of these bridges are in the same state. One is an invitation to disaster; the other will probably carry any load that the roadway will carry for the next twenty-five years.



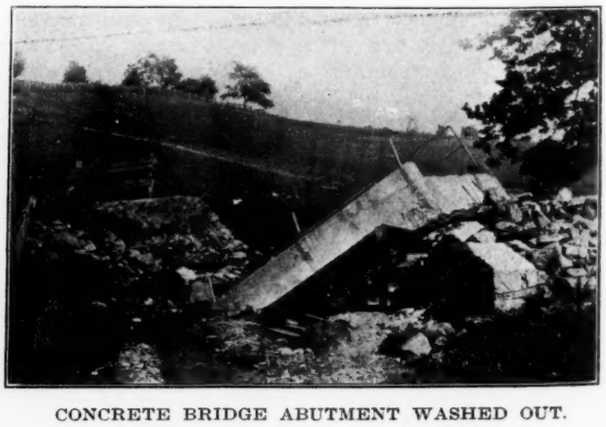
When a highway official knows that half or three-fourths or all of the bridges on the highways in his county are unsafe for some of the traffic using such highways, it would seem to need no argument to convince him that the matter is one of the most vital importance and should be presented as such before the taxpayers or whatever source must be looked to for obtaining the funds necessary for replacing such bridges.

We believe that the highway departments and others having control of state and county highways would be justified in making and strictly enforcing a regulation under which no road of which a bridge comprises a part would have a dollar of state or county funds spent upon the improving of it until such bridge had been rendered safe in all respects for carrying the heaviest load that would use such improved highway within at least the next five years, so far as the development of highway traffic can be foreseen. New bridges should be built for the loads of twenty years hence.

This subject was reported upon at the recent convention of the American Road Builders' Association by a committee of that association and its report is given elsewhere in this issue. The ever-increasing weight of motor trucks is causing the rapid wearing out of many of our older highways, but an even more serious result is that it threatens to rapidly bring about the complete destruction of a large percentage of our older bridges.



STEEL BRIDGE ABUTMENT WASHED OUT.



CONCRETE BRIDGE ABUTMENT WASHED OUT.

If one-third of the hundreds of thousands of bridges in the country are already unsafe for present-day traffic, it certainly is time that the most strenuous efforts were made to replace these; since such replacing, if begun at once, must take several years, and every year will see increasing scores of these bridges falling down under the heavier and ever heavier loads that are being run over them.

Bridge renewal is lagging far behind roadway renewal. It must catch up quickly, even if we have to hold back roadway work to permit it to do so.

HIGHWAY BRIDGES AND HEAVY TRUCKS.

Necessity of Frequent Inspection by Competent Men —How Weak Bridges Can Be Strengthened.

The following report to the American Road Builders' Association by its committee on Methods of Strengthening and Reconstructing Highway Bridges for Heavy Motor Truck Traffic, of which the chairman is Willis Whited, bridge engineer of the Pennsylvania State Highway Department, is a progress report and general in its nature. The need for giving vastly more attention to the subject is discussed and demonstrated by figures elsewhere in this issue.

The auto truck is with us to stay. The number will surely greatly increase and the weight also will show a constant tending to increase as better methods of constructing pavements and better materials and designs for tires, etc., are introduced. It is not necessary to enlarge upon the various uses to which they may be put. Their usefulness in many lines is well established and in others is yet to be developed. A joint committee of this association and of the National Highway Traffic Association is considering the question of the weights, etc., to be allowed on public roads, and until their report is adopted it may not be advisable to lay down definite standards for determining the necessary strength of old bridges; but it may be well to call attention to the following facts: A well-designed, well-constructed, well-maintained reinforced concrete bridge will, so far as we can see, last for centuries. Trucks rated now as heavy may appear puny in 1975. Steel bridges well designed, built and maintained will last at least 50 years and probably much longer. The engineer is, therefore, using good economy in looking well into the future in designing new bridges, especially as a bridge designed to carry a 20-ton truck would not generally cost very much more than one designed to carry a ten-ton truck; whereas if it were designed how to carry a ten-ton truck, and if it were found ten years hence that it must be replaced with one capable of carrying 20 tons, the cost of making the change would be several times greater. If an old bridge is to be strengthened, it is only a temporary makeshift at best, and the engineer is not justified in looking many years ahead in deciding on the assumed loading.

WASH-OUT AT ARCH CULVERT.

In the course of an investigation by a committee of the New York Legislature it developed that there were in that state about 33,800 public highway bridges more than 5 ft. in span, which would indicate that there are about 400,000 such bridges in the United States. It is safe to say that the failure of any one of a very large proportion of them would be liable to cause loss of life. It is also probable that more than 80 per cent are unable to carry a modern heavy truck with a reasonable margin of safety. It will thus be seen what a colossal task it would be to replace all of them with modern structures, and also to what an extent the bridge engineer is the custodian of human life. We will not hazard a guess as to the total cost of such replacement, but it would probably amount to several billions of dollars.

Every one of these bridges should be inspected at least once a year by a competent man. A majority consist of a single span of wooden stringers, with plank floors. In the case of such bridges the main points to be observed are the safety of the abutments and the sufficiency of the width, the safety of the railing, the adequacy of the waterway and the strength and soundness of the stringers and planking. All these points require sound judgment and reasonable amount of engineering knowledge. With the larger bridges the responsibility is greater, and the danger of loss of life in case of failure is also greater. Many bridges require inspection oftener than once a year. All steel bridges should be painted every 3 or 4 years by competent men who are carefully instructed to report all defects observed. Many parts of steel bridges are not accessible for proper inspection without the use of scaffolding such as painters use. It is not always practicable to employ such scaffolding during the annual inspection.

In preparation for the advent of heavy trucks, all public bridges should be examined by competent men who will make a record of the character of the traffic likely to come upon the bridge, the dimensions and conditions of all vital members and the sufficiency of the details, and written reports of such inspections forwarded to the proper state department for record. From these reports it must be decided which bridges require complete reconstruction, which require new superstructures, and which can be repaired and strengthened. The necessary plans can then be prepared and should be checked on the ground. These inspections should be paid for by the public, preferably on a salary or per diam basis. It should as a rule be done by men who are not financially interested in the construction of bridges by contract.

The strengthening of bridges often requires far more engineering skill and ability than the design and construction of new ones.

As to how this work of strengthening should be carried out, much depends on circumstances. Estimates of cost are sometimes misleading. Unit costs of repair or alteration work in place are often more than twice the unit costs of similar material in new work. When an engineer starts to repair an old bridge he is almost certain to find a considerable amount of work that must be done that he had not anticipated. For these reasons it usually is best to have the material furnished or fabricated by contract in the field, the work being done by days' work if a reasonably efficient gang can be organized. Expensive equipment, such as pile-drivers, air-compressors,

etc., may be rented on a per diam basis. If it is a well-defined job, such as replacing a floor system or an abutment, it can be done satisfactorily by contract; otherwise a bidder is confronted by the same difficulty as the engineer in estimating his cost, and will either bid high to cover risk and uncertainty, or will bid reasonable prices, expecting to make up with his bill of extras, which will be no small item. Often, however, a "cost plus" contract is prefered, but it must be so worded that it is either to the contractor's interest to furnish proper tools and equipment or he can be forced to do so. It is not always practicable to insure that the work can be done within the appropriation. Another difficulty often encountered in a repair job handled by a lump-sum contract may be illustrated as follows: The engineer estimates $10,000 as an outside figure for the job, he secures an appropriation of $15,000 to cover extras, the bidders have no way to estimate accurately their cost and are apt to be guided by the amount of the appropriation and bid about $14,900, leaving far too small a margin for extras. If an efficient gang cannot be organized, the "cost plus a fixed sum" system is generally the best, except that on public work public opinion must always be considered, and many people have an idea that the "cost plus a fixed sum contract" is only good for war-work and similar work in which the maximum speed is absolutely necessary regardless of cost.

The committee does not consider that in deciding whether any given member of a bridge needs strengthening it is necessary to hold strictly to the letter of the standard specifications in the matter of unit stresses. In fact, a deficiency of 20 per cent. in material is not serious provided the details are good and the material is in good condition, it being felt that the usual unit stresses adopted make that much allowance for deterioration, besides secondary stresses, etc. Less allowance, however, should be made in the case of floor-beam hangers, stringers and floor beams which are subject to widely and rapidly varying stresses. In considering the strength of a bridge truss, it is not necessary to assume that the bridge is packed full of trucks of maximum weight; but, if the bridge is 16 ft. wide or over, it is always possible that two heavy trucks may pass on the bridge.

The committee feels that in cases where the strengthening of a bridge will make it in effect a permanent structure, the bridge should be designed to carry a truck weighing at least 20 tons, the idea being that the committee having this matter under consideration is concerned primarily with the roadway pavement, as to which the loading specifications can be economically revised within the next ten or fifteen years on account of the wearing out of the pavements, whereas a bridge is a much more permanent structure.

The committee fully recognizes that the immediate strengthening of all the bridges in the country that need it, together with the reconstruction of those which cannot be economically strengthened, is a physical, as well as financial impossibility. It would, therefore, recommend that immediate steps be taken to have a thorough examination made of all important structures by competent engineers and their safe loads determined and indicated by proper signs, to the end that the public be protected so far as is humanly possible. Any person who disregards these notices and suffers disaster has only himself to blame. The work of preparing plans for strengthening should then proceed without delay so that construction will be delayed as little as possible.

The small bridges will generally have to be rebuilt, the steel truss bridges will generally be found fairly strong in the trusses, but altogether too weak in the floor system. These will require strengthening or reconstruction. If the stringers only are somewhat weak their number can be increased at quite a moderate expense. Few of the steel truss bridges are strong enough to carry paved floors, although many can be refloored with 2-inch by 4-inch creosoted wood set on edge and spiked closely together. This will give a much more durable floor and one much less liable to break through under heavy loads. The weight is but little greater than that of a plank floor. Plate girders can often be strengthened by riveting on additional cover plates. Riveted lattice trusses can often be reinforced to carry paved floors without throwing away any existing material.

Pin-connected trusses can rarely be strengthened, and occasions will frequently arise where it is necessary to support the floor by means of timber bents consisting of piles if the bottom is soft, or by means of mud-sills and posts if the bottom is hard. If these are used they should be placed under all the floor beams, the outer posts being about two feet inside the centre lines of the trusses. This method, of course, is not suitable if the stream is likely to carry much drift wood or floating ice.

Timber truss bridges can often be strengthened. If, as is frequently the case, the floor only is weak it is generally possible to put in heavier timber in the floor or to strengthen it with steel to carry heavy trucks.

If a truss is weak it seldom increases its strength to place bents under the floor beams unless all the floor beams are supported in the same way, taking the load almost entirely off the trusses.

Stone arches are almost always amply strong to carry the load if they are in good repair, but it is sometimes necessary to remove the earth covering and grout the joints between the stones to give them a full bearing. Stone arches, moreover, will usually show signs of distress long before total failure. It is rarely possible to strengthen a plain or reinforced concrete arch. Plain concrete arches are more liable to fail suddenly without warning than almost any other kind of a bridge.

It is, of course, understood that all plans for strengthening bridges should be made and carried out under the direction of a competent engineer. Many bridges are not safe to carry auto truck traffic on account of being so narrow as to be dangerous to vehicle traffic at high speed, but it is much better for a truck to reduce speed at a bridge than to break through it. Pending the strengthening of any existing bridge it should be examined by a competent engineer, and the heaviest load which it can safely carry should be indicated by proper sign boards.

The question of detouring traffic while a bridge is under repair is often quite difficult. It is frequently possible to support the old bridge with bents and maintain traffic over the bridge during repairs, although this method adds considerably to the cost of repairs. Sometimes a timber trestle can be built alongside or in the vicinity.

The list of bridges which have failed under heavy trucks, with or without loss of life, is a long one. In the vast majority of cases it is only the planking or the stringers which have broken through.

It is the duty of officials in charge of public highways to maintain them in such condition that they are safe and convenient for all reasonable and lawful traffic which may come upon them, and the limit of loading on bridges of a state should be fixed by statute in order to determine what are reasonable and lawful loads. It being understood always that any private parties desiring to transport heavier loads on them than is provided for

by statute can do so by paying the extra cost of making the bridges of the desired strength.

HIGHWAY WORK CONTEMPLATED FOR 1919

Nearly Four Hundred Million Dollars Already Available, and More Than One Hundred Million Assured for Road Work This Year.

Never before in the history of the world has a nation set aside so large a sum for road construction as is available for that purpose in the United States in the year 1919. In fact, it is a question whether all the nations combined have ever spent so much in a single year. Between half and three-quarters of a billion dollars has been voted, appropriated or otherwise dedicated to road work by the federal government, the states and the counties.

It is not at all probable that all of this will be used this year—in fact, not all of it is available this year. The amount that is already available, as shown in the statement below, totals about $375,000,000. An additional $95,000,000 of federal aid funds will be available before the end of the season (so far as it may be duplicated by state funds), and a good many millions will probably be arranged for by state legislatures, most of which, however, will not be available before next year.

How much of this 375 million dollars will be spent this year will depend, apparently, upon how many reliable contractors can be found, how much labor, material, and road-building machinery, and also upon costs, to a certain extent. The amount and wages of labor in about two hundred counties scattered over the entire country are given elsewhere in this issue. Wages are of course higher than before the war, but in most parts of the country there seems to be plenty of labor.

The cost of road building materials will depend largely upon freight rates. Concerning this the Bureau of Mines reported recently:

A strong feeling exists among all bodies directly concerned in highway work that present freight rates are relatively high in view of the low price that road materials command. In many instances the freight charged is one to two times as much as the cost of the crushed stone, sand or gravel at the quarry or pit. According to a letter from the Railroad Administration to the Highway Industries Association, dated March 5, 1919, no reduction in rates is contemplated except for federal, state or municipal work, and some doubt is expressed regarding a reduction even for materials for such work.

Under date of April 2nd, the Department of Agriculture said that "the present freight rates are one of the principal obstacles to the active resumption and extension of highway activities," but that "it is hoped that a favorable decision will be made in the near future" by the Railroad Administration.

AMOUNTS ALREADY AVAILABLE BY STATES.

From information obtained from state highway officials, the Bureau of Roads, and other reliable sources, we have prepared the following statement of the funds already available for expenditure by each of the states:

Alabama: Federal Aid Funds—$1,676,167. No definite state appropriation or plans.

Arizona: Federal Aid Funds—$1,096,125. Funds available from state—from taxes, $834,000; motor license fees, $160,000; prison labor funds, $70,000.

Arkansas: Federal Aid Funds—$1,338,315. Amount available for road building from counties, sub-divisions of counties, the state, and federal aid, $50,000,000. The program includes 7,000 miles of roads.

California: Federal Aid Funds—$2,433,607. About $20,000,000 available.

Colorado: Federal Aid Funds—$1,375,920. To be expended under supervision of state highway department—$700,000 from half-mill tax; $150,000 from interest on internal improvement fund, from $160,000 to $200,000 from automobile registration, and about $2,600,000 from county tax levies.

Connecticut: Federal Aid Funds—$492,552. State Highway Department will spend about $4,000,000, according to Commissioner Bennett.

Delaware: Federal Aid Funds—$130,350. State will probably spend $2,000,000 and counties $1,000,000, including about $1,000,000 of contracts from last year.

Florida: Federal Aid Funds—$912,450. Commissioner Wm. F. Cocke expects to spend about $6,000,000.

Georgia: Federal Aid Funds—$2,152,943. Counties will do $3,000,000 to $4,000,000 of work with convicts, and bonds for $3,000,000 are contemplated.

Idaho: Federal Aid Funds—$974,371. State road construction funds available, $1,100,000; county co-operative funds estimated at about $1,500,000. (Reported by State Highway Engineer H. C. Allen, April 9.)

Illinois: Federal Aid Funds—$3,506,653. Bond issue for $60,000,000 voted in 1917, legality affirmed by Circuit Court in March, 1919; decision from Supreme Court expected in June. Supt. of Highways S. E. Bradt expects to use $2,000,000 for state aid roads, $6,625,000 for federal aid roads, and $10,000,000 will be spent by townships. It is proposed to do as much work as they can find engineers and contractors for.

Indiana: Federal Aid Funds—$2,163,392. Expects to spend about $2,500,000 in addition to federal aid.

Iowa: Federal Aid Funds—$2,316,227. Hopes to complete the federal aid projects on which they were unable to obtain bids last year. Little additional work contemplated. About $15,000,000, including county and township funds.

Kansas: Federal Aid Funds—$2,295,068. State will raise approximately $875,000 from automobile licenses, all of which must be used for road dragging. By district payment and federal aid it is hoped to lay about 250 miles of brick and concrete roads this year.

Kentucky: Federal Aid Funds—$1,562,266. About $1,500,000 available.

Louisiana: Federal Aid Funds—$1,086,908. Estimated by state highway engineer that $4,674,000 will be spent this year.

Maine: Federal Aid Funds—$771,393. Appropriations made are $375,000 for state highway work, $500,000 for state aid work, and $500,000 for maintenance of state and state aid highways. Also there will be about $500,000 from cities and towns for state aid work, $200,000 for maintenance, and $500,000 for bridges.

Maryland: Federal Aid Funds—$697,750; $3,000,000 state funds will be spent to a large extent this year; also about $800,000 state aid funds.

Massachusetts: Federal Aid Funds—$1,179,697. Probably will be about $4,000,000 available, and possibly more appropriated for special projects.

Michigan: Federal Aid Funds—$2,319,921. About $19,000,000. available from township, county and state taxes, including automobile tax. Petitions made for more than 1,000 miles of district assessment roads; $50,000 bond issue to be voted on in April.

Minnesota: Federal Aid Funds—$2,273,822. Program calls for an expenditure of $7,750,000. Bill for $100,000,000 bond issue has been introduced in legislature.

Mississippi: Federal Aid Funds—$1,434,957. About $3,000,000 is available, about half held over from last year.

Missouri: Federal Aid Funds—$2,713,079. Projects costing $4,000,000 approved and will probably be built this year.

Montana: Federal Aid Funds—$1,592,850. In addition to federal aid, probably $400,000 state aid and $3,500,000 county funds will be spent.

Nebraska: Federal Aid Funds—$1,706,400. Projects prepared for 1919 call for $1,660,000, nearly one-half of which will be federal aid, and $340,000 for county and state aid bridges.

Neveda: Federal Aid Funds—$1,029,358. The state plans to spend $1,300,000.

New Hampshire: Federal Aid Funds—$333,410. Expects to spend about $1,500,000, including federal aid.

New Jersey: Federal Aid Funds—$948,046. The state highway department plans to build 50 miles of road at a cost of $2,000,000. Convicts will be used. The counties and smaller units will probably spend $6,000,000 more.

New Mexico: Federal Aid Funds—$1,273,634. The state highway department has available from state and county tax levies, vehicle and gasoline taxes and licenses, and county bonds, $1,930,000; special levies for Farmington-Albuquerque road, $60,000. County road levies, vehicle licenses and others will add $800,000; giving a total of $4,063,000.

New York: Federal Aid Funds—$3,989,791. A bill passed in March appropriates $5,500,000 for maintenance and repair of state and county highways. About $6,000,000 of construction now under contract will be completed by the state. Probably about $8,500,000 of state aid work will be done; also a considerable amount of county work. The total expenditure will be between $18,000,000 and $23,000,000.

North Carolina: Federal Aid Funds—$1,825,680. All county work, probably about $5,000,000.

North Dakota: Federal Aid Funds—$1,226,375. About $600,000 to be spent by the state and about $2,000,000 by counties and townships.

Ohio: Federal Aid Funds—$2,973,222.

Oklahoma: Federal Aid Funds—$1,844,962. Counties will spend $5,000,000 or more, part from last year's unused appropriations.

Oregon: Federal Aid Funds—$1,259,854. The state has awarded contracts amounting to about $750,000. About $6,000,000 is available.

Pennsylvania: Federal Aid Funds—$3,678,154. A $50,000,000 bond issue was voted last November, and more than $14,000,000 has already been made available, of which $5,000,000 is for permanent state highway construction, $3,000,000 for state aid, $1,200,000 for maintenance and repair of state highways, $500,000 for turnpike condemnation, $1,142,000 for second-class township bonuses.

Rhode Island: Federal Aid Funds—$186,500. About $600,000 will be available for state highway and bridge work.

South Carolina: Federal Aid Funds—$1,147,734. Bond issue cannot be voted until 1920. Plans are under way for constructing 1,060 miles of hard surface and 500 miles of sand-clay roads.

South Dakota: Federal Aid Funds—$1,296,734. About $1,800,000 is left over from 1918 county levies, and the counties will raise about $3,400,000 this year. The state expects to spend about $783,000, including federal aid. A $20,000,000 bond issue is being advocated.

Tennessee: Federal Aid Funds—$1,815,227.

Texas: Federal Aid Funds—$4,678,989. About $20,000,000 worth of work has been definitely decided on, and $5,000,000 is already under construction.

Utah: Federal Aid Funds—$909,205. It is expected that about $3,000,000 will be spent in this state.

Vermont: Federal Aid Funds—$362,650. Funds available—state appropriation, $260,000; 5% state highway tax, $125,000; voted by towns, $100,000; federal aid as above, and an equal amount of state funds; total, $1,210,300. Also $645,000 for maintenance. All of above will be spent that can be wisely.

Virginia: Federal Aid Funds—$1,589,156. There is already under contract or being prepared for letting $3,106,000 worth of roads, not including county expenditures, and in addition to federal aid, but the last probably will not be available. The governor is in favor of a $25,000,000 bond issue.

Washington: Federal Aid Funds—$1,154,550. It is estimated that $8,500,000 will be spent by state and counties in 1919. A $30,000,000 bond issue is proposed.

West Virginia: Federal Aid Funds—$851,534. The counties will have about $16,000,000 available for road work this year.

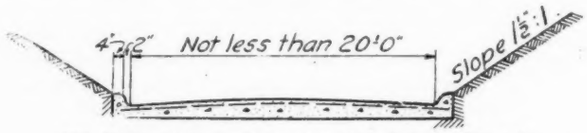
Wisconsin: Federal Aid Funds—$2,040,737. About $10,210,000 will be available, including federal aid; $3,760,000 under state aid law, $4,150,000 under federal aid law, and $2,300,000 for maintenance.

Wyoming: Federal Aid Funds—$980,309. The legislature has appropriated $300,000, and authorized voting on a $2,800,000 bond issue. About $500,000 will be available from county funds.

CONSTRUCTION OF HIGHWAYS IN CUTS.

A modification of the odinary treatment of highways in cuts is being adopted more or less widely where hard surface pavements are used, the most striking feature of the plan being the elimination of shoulders and gutters. Huron county, Ohio, adopted this plan as shown in the accompanying illustration. A single-track concrete road was widened to twenty feet and integral curbs provided. The side slopes of the cut were brought down flush with the top of the curb so that the water draining down the slopes passes directly onto the pavement and flows along the gutter of the same. We understand that the same plan is being adopted for the state highways of Illinois.

This plan eliminates the expense of maintaining shoulders and gutters on steep grades, where the wash is likely to be considerable, and the rutting of the shoulders



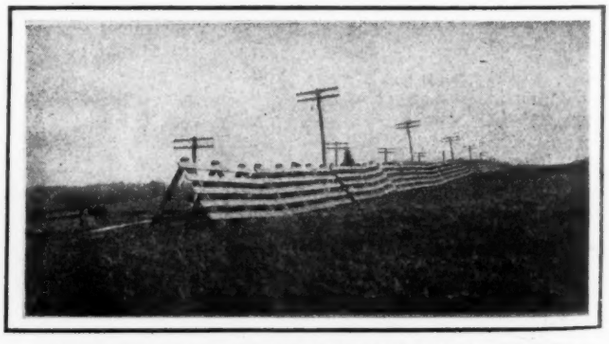
NO-SHOULDER ROAD ON GRADE OVER 4%.

along the edge of the pavement; allows the water to flow away rapidly without damaging the roadway, and materially reduces the amount of excavation. That the latter is the case is readily seen when it is considered that the introduction of a gutter throws the foot of the slope both further out and lower, thus greatly increasing the amount of material to be removed in excavating the side slopes. The pavement of course needs to be wider, allowing sufficient room for the passing of vehicles or for turning around, but the amount saved in excavation alone should go far toward meeting this additional cost, while the cost of maintenance of the pavement will probably be materially less than the combined maintenance of narrow pavement and of shoulders and gutters where the older construction is employed.

SNOW FENCES.

The use of snow fences for preventing drifting in railroad cuts is a practice of many years' standing, but it appears to be only during the past year or two that these fences have been employed along highways. The same principle, however, would of course apply to one as to the other. The illustration shows a snow fence on Lincoln Highway constructed by the State Highway Department of Pennsylvania.

The cost of such a fence is of course no small item, and if it is not thought worth while to endeavor to keep a road open during the winter, this expense would not be warranted. In the case of an important main highway, however, where modern conditions and opinions demand that it shall be passable for all vehicles every day in the year, it may be found that the construction and upkeep of snow fences along the sides of the deeper cuts would involve less expenditure than the removal of snow from such cuts during and after every snow storm; in addition to which it is to be considered that, where drifts tend to form, it is impracticable to keep snow plows or other apparatus at work on each cut continuously so as to prevent such formation, and therefore the snow fence would insure more continuous freedom from snow drifts than any reasonable amount of snow fighting.



SNOW FENCE ON LINCOLN HIGHWAY IN BEAVER COUNTY, PENNSYLVANIA.

BRIDGE FAILURES.

State and County.	Number of bridges on county roads.	Have any broken because too light for traffic?	How many are considered unsafe for the heaviest traffic?
Arkansas:			
Hempstead	Many	No	10
Little River	14	No	None
California:			
San Benito	11	No	2
Florida:			
Citrus	4 across river	No	None
Lake	6 steel, many wooden	No	50% of wooden bridges
Lee	About 1,000	No	None
Georgia:			
Chattahoochee	12 or 15	No	2 or 3
Lawrence	About 6 miles	Yes	Can't say
Liberty	Do not know	Yes	75%
Illinois:			
Christian	100 or more large ones	Yes	50%
DeWitt	About 1,000, all sizes	No	Not estimated
Marshall	About 1,300 bridges & culverts	Yes	5 to 10%
McDonough	Culverts & bridges average 5 per mile	Only old wooden bridges	5½%
McHenry	125	One	50% not safe for 12-ton engine
Stephenson	3,000	No	30%
Washington	2,000	Badly damaged.	About 50%
Whiteside	.....	No	10%
Williamson	2,400	No	Very few
Winnebago	About 2 per mile	Yes	75%
Woodford	4 per mile	No	6
Indiana:			
Dubois	Many small, 7 large	None	6 large (f)
Fountain	No idea	No	Several
Hancock	Not known	No	Very few
Howard	200	No	None
Jackson	Probably 350	Most must be strengthened or rebuilt soon.	About 50%
Marion	About 83	None	None
Randolph	Unknown	No	Very few
Tippecanoe	No record	No	3 or 4 small ones
Tipton	None	No	None
Vigo	500	10 or 15	300
Wayne	75	None	3
Iowa:			
Adair	39	No	16
Adams	About 800	Traction engines went through 3 or 4	About 100
Appanoose	About 1,700	Yes	Many
Bremer	2,700 culverts & bridges	No	12%
Cerro Gordo	3,800	No	166
Cherokee	About 600 bridges & culverts	No	None
Fayette	.....	Yes	Unknown
Greene	.....	....	50
Humboldt	About 1,150	Yes	10
Ida	About 400	One	Probably 10%
Jasper	....	No	About 75%
Johnson	Probably 1,500	No; kept heavy traffic off.	90% on main roads, 50% on secondary roads
Kossuth	950	No	....
Lee	.....	....	50%
Lyon	Several hundred	A few wooden bridges	10 to 15 old light steel ones
Mills	About 2,000	Several	About 30%
Muscatine	40 on county roads	No	4 on county roads
Mahaska	About 450	Some wood bridges	75
Osceola	About 1,300	No	All temporary ones
Palo Alto	About 1,100, culverts & bridges	Yes	About 20%
Sac	Average 5 waterways per mile	Yes	No estimate; some
Tama	About 8,000	Yes	50%
Kansas:			
Allen	356	Yes	50%
Anderson	About 50	No	None
Chase	22 large bridges	One	8
Doniphan	464 costing over $600	A few	20
Douglass	.....	....	....
Kingman	Count not completed	Yes	35
Labette	.....	No	None
Meade	.....	No	None
Ness	17 wood floors and piles	No	All
Republic	Do not know	Yes	....
Rooks	20	Yes	7
Sedgwick	About 1,000	No	60%
Wilson	Not known	No	4 or 5
Kentucky:			
Greenup	.....	No	One
Henderson	150 or more	Some wooden bridges	....
Hickman	1,400 bridges & culverts	100	200
Menifee	None	....	....
Morgan	15 steel, a number of wood	No	None
Nicholas	128	2 (e)	20
Oldham	43	Yes	....
Trimble	2 steel, several concrete	No	4 or more
Whitley	About 50	One	One
Louisiana:			
Caddo (Parish)	50 or more	10, all built for 10 or 15 tons	None
Jackson	4 or 5 steel	No	....
W. Feliciana	9	No	None
Maryland:			
Allegany	71 long; numerous small wooden ones	3 wooden ones	None of the 71
Anne Arundel	Large number	Yes	All steel & concr. bridges are safe
Kent	About 10	No	All of them next year; heavy traffic just beginning
Talbot	About 225, 16 ft. long & over	No	None
Wicomico	About 200	Some wooden bridges	Fully half
Michigan:			
Berrien	15 over 30 ft. span	No	None yet
Cass	About 90	No	About 50
Dickinson	9	No	One
Ingham	25	No	None
Kalkaska	40 or 50	No	None
Macomb	20 over 30 ft. span	No	14
Menonimee	6	No	None
Minnesota:			
Blue Earth	About 500	No	About 50%
Clay	20	No	....
Cottonwood	Only concrete culverts	Yes	Very few
Crow Wing	200 state, county & town	No	80% county & town
Goodhue	131, 10 ft. span up	No	One
Grant	15	No	None
Isanti	4	No	1
Itasca	95	Some have been strained	About 25
Jackson	16	Yes	3
Martin	25 about $3,000 each, many smaller	No	Not known
Morrison	About 10	No	None
Roseau	12	No	2
Todd	No figures	None	....
Mississippi:			
Coahoma	About 200	No	25 or more
Missouri:			
Butler	90 steel & concrete, a few wood	No	None of steel
Callaway	185	2, old rusty steel	75%
Clark	About 100	No	Very few
Harrison	About 100	No	About 50%
Jasper	About 130	No	About 20%
Lincoln	54 steel over 30 ft. (a)	No	Some old culverts
Miller	7	No	All
Monroe	.....	None	Many
Polk	50	No	None
Webster	2	None	None

BRIDGE FAILURES—(Continued).

State and County.	Number of bridges on county roads.	Have any broken because too light for traffic?	How many are considered unsafe for the heaviest traffic?
Montana:			
Granite	4 large, many small	....	....
Nebraska:			
Dakota	Not known	No	None
Fillmore	320	Yes	50%
Gage	About 120 large	No	20
Keyapaha	6	None	One
New Jersey:			
Burlington	500	Yes	400
Gloucester	Co. roads 62, twp. roads 650	3 old ones	Co. roads 3, twp. roads 35
Passaic	About 700	Yes	About 5%
Salem	.....	No	2
Somerset	About 750	(b)	At least 10 large ones
Sussex	37	None	None
New Mexico:			
Luna	Very few	No	None
New York:			
Cayuga	339 under 20 ft. span, 137 over 20 ft.	No	10 to 20
Dutchess	1,006	Yes	20
Franklin	586 over 5 ft.	No	None
Herkimer	1,500	Yes	2/3
Niagara	160 from 5ft span to 380 ft.	One	All more than 10 years old
Orleans	402 5 ft. span or more	1 or 2	About 40%
Saratoga	670	2	40%
Wayne	369	3 or 4	10%
Yates	100	Yes	Most of them
North Carolina:			
Davidson	300	Yes	12
Wayne	Not known	All wood, yes	All
North Dakota:			
Divide	2	....	....
Ohio:			
Guernsey	About 4 per mile	No	10 or 15
Highland	.....	Yes	Many
Huron	.....	No	....
Madison	.....	No	3 or 4
Meigs	Quite a few	No	....
Muskingum	About 1,200	Yes	The majority
Wood	1,200	20	10
Oklahoma:			
Bryan	No data	Yes	About 75%
Craig	About 40	None	2
Garfield	Several hundred	No	....
Harper	About 15 good ones	No	None
Kingfisher	About 200	Yes	65%
McClain	2	No	None of late construction
Major	.....	No	Some wooden ones
Pennsylvania:			
Lebanon	About 30	Not in last 2 years	Limited to 10 tons
Mercer	.....	No	2
South Carolina:			
Florence	1,000 large & small	Yes	50%
Deuel	500	No	Some old wooden ones
Tennessee:			
Greene	38 large ones	No	50%
Hardin	About 50 steel	No	None
Haywood	About 300	Yes	100
Lewis	None yet	....	....
White	6	No	None
Texas:			
Castro	None	....	....
Cornal	2 long span, 5 culverts	No	One
Dallas	400	No	None on main roads, 50% on side roads
DeWitt	About 50	No	None
Floyd	4	No	None
Frio	28 or 30	Yes	None
Lubbock	One	No	None
Taylor	About 50	Yes	50%
Virginia:			
Greensville	Great many	No	A few wooden ones
Washington:			
Clarke	About 50	No	About 20
Columbia	50	No	None safe
Douglas	4 concrete, great many wood	No	Most of the wooden
Kittitas	About 60 under 30 ft., 14 longer	No	None
Lincoln	400	No, but require constant repair	About 5%
Pend Oreille	Several pile & frame	No	None
Pierce	About 50	Yes	About 12
Skamania	About 25	No; one condemned	20 (c)
Spokane	275 with over 30 ft. spans	2 or 3 small ones	Very few
West Virginia:			
Fayette	About 500	No	A few old timber bridges
Hancock	About 120, mostly small	No (d)	None
Harrison	200	No	10%
Monongolia	About 300 over 20 ft. span	No	....
Nicholas	14	No	None
Raleigh	5, all concrete	No	None
Webster	10	No	7 steel bridges
Wisconsin:			
Adams	About 50	....	None
Forest	.....	No	Old wooden ones
Grant	.....	No	None
Jefferson	17	No	2
Juneau	70	No	35
Outagamie	About 8	Yes	....
Sauk	400	None	One
Washburn	3 on federal trunk system	No	None
Wood	.....	No	None on main roads
Wyoming:			
Platte	About 75	No	15

[a]Bridges and culverts, 3 to mile. [b]Con tinually renewing bridges broken down by heavy traffic. [c]All of recent build safe. [d]A few small wooden bridges have broken from age and been replaced with stone or concrete. [e]Are gradually concreting all bridges. [f]All late bridges designed for 20-ton loads.

COUNTY WORK CONTEMPLATED FOR 1919.

State and County	Kinds of surface to be constructed	Amount	Will reinforcement be used in concrete pavements?	Distance between expansion joints
Arkansas:				
Hempstead	27 mi. brick or warrenite. 100 mi. gravel	125 mi	....	....
Little River	Gravel	40 mi	No	About 30'
California:				
San Benito	Macadam, 6½ mi.; gravel several mi	....	....	....
Florida:				
Jackson	Macadam, 12 mi.; gravel, 10 mi.	22 mi.	....	....
Lake	Sand clay	10 mi.	....	....
Leon	Sand clay	10 mi.	....	....
Madison	Sand clay	10 mi.	....	....
Orange	Sand clay	10 mi.	....	....
Polk	Sand clay	10 mi.	....	....
Volusia	Sand clay	10 mi.	....	....
Iowa:				
Adair	Gravel	25 mi.	....	....
Adams	Gravel	25 mi.	....	....
Allamakee	Gravel	25 mi.	....	....
Audubon	Gravel	25 mi.	....	....
Benton	Gravel	25 mi.	....	....
Boone	Gravel	25 mi.	....	....
Bremer	Gravel	25 mi.	....	....
Buchanan	Gravel	25 mi.	....	....
Buena Vista	Gravel	25 mi.	....	....
Butler	Gravel	25 mi.	....	....
Calhoun	Gravel	25 mi.	....	....
Carroll	Gravel	25 mi.	....	....
Cass	Gravel	25 mi.	....	....
Cedar	Gravel	25 mi.	....	....
Cherokee	Gravel	25 mi.	....	....
Chickasaw	Gravel	25 mi.	....	....
Clay	Gravel	25 mi.	....	....
Clayton	Gravel	25 mi.	....	....
Crawford	Gravel	25 mi.	....	....
Dallas	Gravel	25 mi.	....	....
Delaware	Gravel	25 mi.	....	....
Dickinson	Gravel	25 mi.	....	....
Dubuque	Gravel	25 mi.	....	....
Emmet	Gravel	25 mi.	....	....
Fayette	Gravel	25 mi.	....	....
Floyd	Gravel	25 mi.	....	....
Franklin	Gravel	25 mi.	....	....
Fremont	Gravel	25 mi.	....	....
Greene	Gravel	25 mi.	....	....
Grundy	Gravel	25 mi.	....	....
Guthrie	Gravel	25 mi.	....	....
Hamilton	Gravel	25 mi.	....	....
Hancock	Gravel	25 mi.	....	....
Hardin	Gravel	25 mi.	....	....
Harrison	Gravel	25 mi.	....	....
Henry	Gravel	25 mi.	....	....
Howard	Gravel	25 mi.	....	....
Humboldt	Gravel	25 mi.	....	....
Ida	Gravel	25 mi.	....	....
Iowa	Gravel	25 mi.	....	....
Jackson	Gravel	25 mi.	....	....
Jasper	Gravel	25 mi.	....	....
Jefferson	Gravel	25 mi.	....	....
Johnson	Gravel	25 mi.	....	....
Jones	Gravel	25 mi.	....	....
Keokuk	Gravel	25 mi.	....	....
Kossuth	Gravel	25 mi.	....	....
Lee	Gravel	25 mi.	....	....
Linn	Gravel	25 mi.	....	....
Louisa	Gravel	25 mi.	....	....
Lyon	Gravel	25 mi.	....	....
Madison	Gravel	25 mi.	....	....
Mahaska	Gravel	25 mi.	....	....
Marion	Gravel	25 mi.	....	....
Marshall	Gravel	25 mi.	....	....
Mills	Gravel	25 mi.	....	....
Mitchell	Gravel	25 mi.	....	....
Monona	Gravel	25 mi.	....	....
Monroe	Gravel	25 mi.	....	....
Montgomery	Gravel	25 mi.	....	....
Muscatine	Gravel	25 mi.	....	....
O'Brien	Gravel	25 mi.	....	....
Osceola	Gravel	25 mi.	....	....
Page	Gravel	25 mi.	....	....
Palo Alto	Gravel	25 mi.	....	....
Plymouth	Gravel	25 mi.	....	....
Pocahontas	Gravel	25 mi.	....	....
Polk	Gravel	25 mi.	....	....
Pottawattamie	Gravel	25 mi.	....	....
Poweshiek	Gravel	25 mi.	....	....
Ringgold	Gravel	25 mi.	....	....
Sac	25 mi. gravel, 140 mi. maintenance	25 mi.	....	....
Tama	Dirt road	$45,000	....	....
Kansas:				
Allen	8 mi. macadam, 12 mi. concrete, 5 mi. gravel, 4 mi. resurface	29 mi.	Yes	30 ft.

Florida:				
Citrus	2.2 mi. concrete surface; 130 mi. repair work	2.2 mi.	Yes	10'
Lake	Street work	$125,000	No	50'
Lee	25 mi. grading; 25 mi. with local material	50 mi.	....	....
Georgia:				
Chattahoochee	Sand-clay roads	10 mi.	....	....
Laurence	Sand-clay	$130,000	No	....
Liberty	Sand-clay	50 mi.	No	....
Illinois:				
Christian	Oiled earth	$24,596	....	....
De Witt	5 or 6 mi. earth	$15,000	....	....
Marshall	12.5 mi. concr., 9.0 mi. grade and drain	21.5 mi.	No	....
McDonough	100 mi. oiled earth, 10 mi. earth	110 mi.	....	....
McHenry	Concrete	$25,000 (c)	No	50' on roads, 30' on city pavements
Stephenson	1 mi. brick	$23,000	No	None
Washington	Macadam or gravel	$16,000	....	....
Whiteside	23 mi. concrete, 10 mi. gravel	33 mi.	....	....
Williamson	3 mi. bituminous macadam, 5-7 mi. concrete	8-10 mi.	Yes	....
Winnebago	8¾ mi. concrete, ⅓ mi. brick	9 mi.	No	Don't use them
Woodford	Oiled earth	132,000 sq. yd.	No	....
Indiana:				
Adams	Macadam, 45 mi.	$261,000	....	....
Dubois	7 mi. macadam, 6½ mi. macadam treated	13½ mi.	No concrete paving	....
Hancock	25 mi. gravel, (5 mi. macadam (a)	30 mi.	Yes	30'
Howard	27½ mi. concr., asph. concr. stone macadam, gravel & brick	$300,000	Yes	30'
Jackson	Stone and gravel	4 mi.	Yes	25' to 30'
Marion	Concrete, 45 mi.; brick, 20 mi.; asphalt, 18 mi.	$500,000	Yes	End of each day's run
Randolph	20,000 sq. yd. brick; 10 mi. stone; 4 mi. gravel.	15 mi.	Yes	36'
Tippecanoe	6 mi. brick, 2 mi. concr., 20 mi. gravel	28 mi.	Yes	50'
Tipton	8 mi. brick	94,000 sq. yd.	Yes	30' to 35'
Vigo	20 mi. hard road; 20 mi. stone and gravel	40 mi.	Yes	33'
Wayne	20,000 sq. yd. rein. concr.; 275,000 sq. yd. plain concr.	295,000 sq. yd.	In part	36'
Iowa:				
Adair	Grading and maintaining	$20,000	....	....
Adams	Repairs, $15,000; 10 mi. permanent grades	....	I would	(b)
Appanoose	Permanent dirt road	$40,000	....	....
Bremer	2 mi. gravel, 3 or 4 mi. grading	5½ mi.	....	....
Cerro Gordo	7.5 mi. concrete, 10 mi. gravel	17.5 mi.	Yes	None
Cherokee	Dirt roads	15 mi.	....	....
Fayette	Earth road	$35,000	....	....
Humboldt	1¼ mi. paving, 10 mi. gravel	11¼ mi.	We will	About 35'
Ida	Maintenance	$14,000	....	....
Jasper	Dirt road, $30,000; gravel, $6,000	$36,000	....	....
Johnson	1.1 mi. hard surfacing, 10 mi. earth work	11.1 mi.	Yes	None
Kossuth	Earth grading and gravel-ing	$50,000	....	....
Lee	Maintenance	....	....	....
Lyon	40,000 cu. yd. permanent grading	$15,000	....	....
Mills	Earthwork only	$30,000	....	....
Muscatine	7 mi. grading & clay surfacing	$51,000	....	....
Mahaska	Ordinary road work	$30,000	....	....
Osceola	20 blocks city pavement, 25 mi. gravel highways	27 mi.	Yes	25' to 50'
Palo Alto	Graveling	60 mi.	No	40'
Anderson	Hard surface	30 mi.	....	....
Chase	Concrete or brick	33 mi.	....	33'
Doniphan	Probably none till 1920	....	No	Not determined
Douglas	Kind not determined	18 mi.	No	....
Kingman	Grading	$15,894	....	....
Labette	Gravel road	22 mi.	....	....
Meade	Grading	30 mi.	....	....
Ness	Dirt roads	....	....	....
Republic	Improved earth	150 mi.	....	....
Rooks	Earth roads $10,000, gravel $2,000	$12,000	....	....
Sedgwick	7⅜ mi. concrete, 12 mi. brick	19⅜ mi.	No	....
Wilson	Gravel road	25 mi.	....	....
Kentucky:				
Greenup	Earth road	10 mi.	....	....
Henderson	12 mi., mostly gravel	$135,000	....	....
Menifee	About 2 mi. gravel	$8,000	No	....
Morgan	.....	$25,000	....	....
Nicholas	Waterbound macadam	$35,000	....	....
Oldham	Waterbound macadam	4 miles	....	....
Louisiana:				
Caddo	Gravel, asphalt surface	$200,000	....	....
Jackson	Graded & gravel	25-40 mi.	No	....
West Feliciana	Gravel	$350,000	....	....
Maryland:				
Allegany	Concrete, 14'-20' wide	$250,000	....	End of day's work
Anne Arundel	Gravel, shell, cinder, slag, concrete	$80,000	No	None
Kent	Macadam 4½ mi., concrete 3½ mi.	8 mi.	No	100 ft.
Talbot	None	....	No	60 ft.
Wicomico	Earth, sand-clay, shell, macadam, bit. mac., concrete	$50,000	No	50 ft.
Michigan:				
Berrien	Macadam 10 mi.; asph. concrete 2 mi.; brick 1½ mi.	13½	No	25 to 33 ft.
Cass	Gravel	60 mi.	Yes	35 ft.
Ingham	Gravel, 20 mi.; concrete, 1½ mi.	21½ mi.	Occasionally	30 to 50 ft.
Kalkaska	Gravel	2 mi.	Yes	35 ft.
Macomb	Gravel & slag, 20 mi.; asph. macadam, 3½ mi.; concrete, 6¾ mi.; asph. concrete, 10¼ mi.	40½ mi.	No	....
Menominee	Crushed gravel	2 mi.	....	....
Minnesota:				
Blue Earth	Earth and gravel	$60,000	....	....
Cottonwood	Grading, 50 mi.; gravel, 10 mi.	$120,000	....	....
Crow Wing	Grading and gravel, 25 mi.	$100,000	....	....
Goodhue	Grading, 18 mi.; gravel, 40 mi.	$149,000	....	....
Grant	Earth, 5 mi.; gravel, 6 mi.	$53,000	....	....
Isanti	Grading and gravel	22 mi.	....	....
Itasca	Gravel, 35 mi.	$150,000	....	....
Jackson	Grading, 30 mi.	$60,000	....	....
Martin	Grading, 34 mi.; gravel, 30 mi.	$200,000	....	....
Morrison	Gravel, 60 mi.; concrete, 14 mi.	74 mi.	....	....
Roseau	Earth, 13½ mi.	$27,239	....	....
Todd	Grading, 20 mi.; gravel, 7 mi.	27 mi.	....	....
Mississippi:				
Coahoma	Gravel, 38 mi.; asphalt or concrete, 22 mi.	60 mi.	....	....
Missouri:				
Butler	Earth road foundation	$50,000	....	....
Callaway	Gravel and macadam	7½ mi.	....	....
Clark	Earth roads	50 mi.	....	....
Harrison	Concrete	9½ mi.	No	20 ft.
Lincoln	Gravel	14 mi.	Yes	20 ft.
Miller	Earth roads	$60,000	No	....
Monroe	Grading and culverts	$20,000	....	....
Polk	Gravel, 13½ mi.	$42,000	No	30 ft.
Montana:				
Granite	Earth, 10 mi.	$20,000	....	....
Nebraska:				
Dakota	Grade & surface	20 mi.	No	....

COUNTY WORK CONTEMPLATED FOR 1919—(Continued).

State and County	Kinds of surface to be constructed	Amount	Will reinforcement be used in concrete pavements?	Distance between expansion joints
Nebraska (Continued):				
Fillmore	Grading	35 mi.	....	....
Gage	Grading, 90 mi.; gravel, 35 mi.	125 mi.	....	....
New Jersey:				
Burlington	.....	$600,000	....	....
Gloucester	Concrete, 2 mi.; gravel, 2.6 mi.; bit. macadam, 1¼ mi.	5.9 mi.	Yes	33⅓ ft.
Passaic	Concrete, $190,000; bit. concrete, $168,000; granite, $175,000; asphalt, $40,000; surfacing $295,000	$868,000	Yes	35 ft.
Salem	Concrete, 4.76 mi.; asphalt, 2.61 mi.; gravel, 3.38 mi.	10.75 mi.	No	36 ft.
Somerset	Macadam	$58,500	....	....
Sussex	.....	$300,000	....	....
New Mexico:				
Luna	Gravel	$65,000	....	....
New York:				
Cayuga	Macadam (and maintain 90 mi.)	20 mi.	....	....
Dutchess	Gravel, 10 mi.; concrete, ½ mi.; bit. macadam, 2 mi.	12½ mi.	No	35 ft.
Franklin	Bit. resurfacing 3" thick	7 mi.	....	30 ft.
Herkimer	Macadam	$650,000	No	....
Niagara	Bit. macadam, 13 mi.; concrete, 8 mi.	$376,000	Some	30 to 32 ft.
Orleans	None	....	....	....
Saratoga	Concrete, 3½ mi.; others, $110,000	$185,000	Over clay	30 ft.
Wayne	Macadam, 10¼ mi.; gravel, 19 mi.	$88,973	....	....
Yates	.....	12½ mi.	No	30 ft.
North Carolina:				
Davidson	Concrete, 12 mi.; sand-clay, 25 mi.	37 mi.	Will	30 ft.
Mitchell	.....	$100,000	....	....
Wayne	Sand-clay and concrete	$70,000	....	....
North Dakota:				
Divide	.....	10 mi.	....	....
Ohio:				
Guernsey	Grading, 2 mi.; macadam, 3 mi.; concrete, 5 mi.; brick, ¼ mi.	10¼ mi.	No	50 ft.
Highland	Tar macadam, $250,000; macadam, $300,000; bridges, $120,000; maintenance, $62,000	$732,000	No	....
Huron	Concrete, 16 mi.; brick, 4 mi.	20 mi.	On 16' or wider	75 ft.
Madison	Tar macadam, 5.92 mi.; concrete, 2.5 mi.	8.42 mi.	Yes	60 ft.
Meigs	Tar macadam, 10 mi.	$200,000	....	....
Muskingum	Brick, 6½ mi.; concrete, 9 mi.	$495,000	No	60 ft.
Wood	Concrete, 57,000 sq. yd.; asph. concrete, 77,000 sq. yds.; bit. macadam, 70,000 sq. yd.	204,000 sq. yd.	Yes	40 to 100 ft.
Oklahoma:			....	....
Bryan	Concrete	25 mi.	....	....
Craig	.....	$55,000	No	25 to 33 ft.
Garfield	Earth work	$75,000	....	....
Harper	Earth roads	10 mi.	....	....
Kingfisher	Earth roads and bridges	$80,000	....	....
Major	Grading	10 mi.	....	....
McClain	.....	$20,000	....	....
Pennsylvania:				
Lebanon	Macadam, 10 mi.; tarvia, 3 mi.	13 mi.	....	....
Mercer	None by county	....	Yes	30 ft.
South Carolina:				
Florence	Hard surface, $45,000; sand-clay, $40,000	$85,000	....	....
South Dakota:				
Deuel	Gravel	$60,000	....	....
Tennessee:				
Greene	Grading, 50 mi.; macadam, 50 mi.	$500,000 (c)	No	....
Haywood	Grading	25 mi.	....	....
Lewis	Gravel and chert	50 mi.	....	....
White	Macadam—quite a lot	....	....	....
Texas:			....	....
Castro	Earth roads	30 mi.	Yes	150 ft.
Dallas	.....	$500,000	....	....
Trio	Only repairing	....	....	....
Lubbock	Dirt roads	....	....	....
Taylor	Gravel, 50 mi.; earth, 20 mi.	$150,000	....	....
Virginia:			....	....
Greensville	Resurfacing sand-clay by towns	....	....	....
Washington:				
Clarke	Concrete and bitulithic	33 mi.	No	30 ft.
Columbia	Macadam	1½ mi.	....	....
Kittitas	Crushed gravel, 5 mi.	$23,000	No	30 ft.
Lincoln	Grading and gravel	$100,000	....	....
Pend Oreille	Gravel	2.42 mi.	....	....
Pierce	Total pavement, 6 mi.	$120,000	Some	30 ft.
Skamania	Gravel & broken stone, 50 mi.	$50,000	....	....
Spokane	Concrete, 180,000 sq. yds.	$350,000	Where subgrade is weak	30 ft.
West Virginia:				
Fayette	Concrete, $300,000; asph. concrete, $100,000; asph. macadam, $200,000	$600,000	No	End of day's work
Hancock	Brick, 4.5 mi.; concrete, 5 mi.	9.5 mi.	No	....
Monogalia	Concrete, 5 mi.; grading, 2 mi.	$150,000	In places	Not used
Nicholas	Improved dirt	10 mi.	....	....
Raleigh	Bit. macadam, 20 mi.; grading, 20 mi.	40 mi.	No	30 ft.
Webster	Improved dirt	10-20 mi.	....	....
Wisconsin:			....	....
Adams	Gravel, 1 mi.; sand-clay, 10 mi.	11 mi.	....	....
Forest	Grading, 25 mi.; gravel, 6 mi.	$90,000	....	....
Grant	Concrete, $2,000; macadam, $15,000; grading, $80,000	$97,000	....	....
Jefferson	.....	$160,000	....	....
Juneau	Concrete, 28 mi.	$40,000	....	....
Outagamie	Gravel, macadam & bridges	$520,000	No	35 ft.
Sauk	Mostly grading	$200,000	....	....
Washburn		$30,000	....	....
Wyoming:				
Platte	Earth road, 75 mi.	$10,000	....	....

a—possibly some brick and concrete; b—every time work is stopped for more than one hour; c—total amount of cash available.

RESULTS OF HEAVY TRAFFIC.

State and County.	Greatest weight of combined load and truck using highways	Legal limit of weight	Have any roads been damaged by heavy trucks?	What changes have been made in road construction because of heavy trucks?	Are such changes contemplated or recommended?
Arkansas:					
Hempstead	7 tons	None	Yes	To hard surface	....
California:					
San Benito	.....	None	Yes	None	No
Florida:					
Citrus	3 tons	None	Yes	Rock instead of clay for repairs; new roads concrete	....
Lake	5 tons	None	Yes	Better foundations	....
Lee	3 tons	None	No	None	....
Georgia:					
Chattahoochee	2 tons	None	No	None	....
Laurens	10 tons	None	Yes	None	For bridges
Liberty	6 tons	None	Yes	None	Recommend restricting loads
Illinois:					
Christian	6 tons	None	Yes	None	Yes
DeWitt	5 tons	None	Yes	None	....
Marshall	10 tons	None	Earth and gravel badly	Better culverts and bridges	Yes
McDonough	8 tons	None	....	....	....
McHenry	4 tons	None	Township gravel roads	None	....
Stephenson	5 tons	None	No	Increase concrete base	Recommend limiting weight
Washington	....	None	Yes	....	Yes
Whiteside	10 tons	None	Yes	None	Recommended
Williamson	5 tons	....	No	None	No
Winnebago	15 tons	None	Yes	From macadam and gravel to concrete	....
Woodford	3½ tons	....	No	None	By the state
Indiana:					
Adams	5 tons	None except on soft roads	Yes	None	Yes
Dubois	3 tons	None	No	None	Yes
Hancock	Heaviest in use	By wheel width	Yes	Changing to hard surface	....
Howard	4 to 8 tons	None	Gravel and macadam	Change to hard surface	....
Jackson	7 to 8 tons	1,000 lb. per inch width of tire	Earth, gravel and macadam	Better drainage and grading, thicker metal	Yes
Marion	6 tons	None	Yes	All roads hard surface	....
Randolph	8 tons	....	Yes	Main roads hard surface	....
Tippecanoe	8 tons	5 tons	Yes	Better drainage; hard surface for some	....
Tipton	9 tons	None, if tires wide	Yes	....	Hard surface demanded
Vigo	20 tons	....	Yes	Hard surface	....
Wayne	7 tons	10 tons	Gravel, in soft weather	Hard surface	All main highways to be hard surface
Iowa:					
Adair	8 tons	None	....	....	....
Adams	6 tons	None	All dirt roads	....	Should be
Appanoose	2 tons	....	Yes	None	Recommended
Bremer	5 tons	....	All dirt roads	....	Surfacing necessary
Cerro Gordo	8 tons	None	Yes	Change from gravel to concrete	....
Cherokee	3½ tons	....	Dirt roads	....	Will in near future
Fayette	2½ tons	None	Yes	Not yet	Yes
Humboldt	7 tons	None	Gravel roads	Pave main roads, increase depth of gravel on others	....
Ida	7 tons*	None	No	None	Yes
Jasper	5 tons	None	Yes	....	....
Johnson	8-10 tons	None	Yes	None	Some day
Kossuth	3 tons	None	No	None	....
Lee	3½ tons	None	Earth roads	....	....
Lyon	3 to 4 tons	....	....	....	....
Mahaska	6 tons	None	Yes	None	Should be limit to speed and load
Mills	7½ tons	None	All earth roads	....	....
Muscatine	12-14 tons	None	Yes	None	Will build for heavier traffic
Osceola	8 to 10 tons	None	Yes	Thicker base, better construction	....
Palo Alto	7 tons	None	Earth roads	....	....
Sac	6 tons	None	Gravel and earth nearly ruined	Not yet	Must pave main roads, heavier gravel on side roads
Tama	5 tons	None	Dirt roads	Increased width	....
Kansas:					
Allen	10 tons	None	Yes	....	Recommend
Anderson	2 tons	None	No	None	....
Chase	5 tons	None	No	Will use hard surface	....
Doniphan	6 tons	....	Earth roads	....	....
Douglas	3 tons	None	....	....	....
Kingman	13 tons	....	After rains	None	....
Labette	.....	None	No	None	....
Ness	.....	None	No	....	....
Republic	3½ tons	None	....	....	....
Rooks	5 tons	None	No	None	....
Sedgwick	9 tons	....	Only earth	....	....
Wilson	10 tons	None	Earth and gravel	None	....
Kentucky:					
Greenup	5 tons	....	No	None	....
Henderson	7 tons	15 ton	Yes	Increase thickness, improve drainage	....
Morgan	5 tons	None	Very little	None	No
Nicholas	10 tons	None	Yes	Not yet	Yes
Oldham	6 tons	....	Yes	None	Yes
Louisiana:					
Caddo	9 or 10 tons	None	Considerably	Change to asph. concrete	....
West Feliciana	1 to 2 tons	None	No	....	....
Maryland:					
Allegany	10 tons	None	Yes	....	Will abandon macadam and thicken concrete
Anne Arundel	11 tons	650 lbs per inch width of tire	Yes	Use only concrete for main roads	....
Kent	7 tons	About 7 tons	No	None	No
Talbot	6 tons	None	No	....	Use concrete for improved roads
Wicomico	10 tons	....	Yes	Abandoned shell, treat macadam with tar or asph.	Recommend concrete, 6 in. min. thickness

RESULTS OF HEAVY TRAFFIC—(Continued).

State and County.	Greatest weight of combined load and truck using highways.	Legal limit of weight	Have any roads been damaged by heavy trucks?	What changes have been made in road construction because of heavy trucks?	Are such changes contemplated or recommended?
Michigan:					
Berrien	12 tons	Depends on wheel base	No	None	Will increase base 20%
Cass	10 tons	Depends on wheel base	Yes	None yet	Yes
Ingham	10 tons	Depends on wheel base	Yes	In some places concrete replacing gravel	....
Kalkaska	15-18 tons	....	No standard roads	None	When trucking becomes heavy
Macomb	9-11 tons	Depends on wheel base	Yes	Increase depth and improve quality	....
Menominee	10 tons	....	No	None	No
Minnesota:					
Blue Earth	4 tons	None	A great deal	None yet	Recommend concrete
Cottonwood	6 tons	None	Yes	....	Propose concrete
Crow Wing	5 tons	None	No	....	Contemplate paving
Goodhue	.....	None	....	Concrete will replace gravel	....
Grant	3 tons	None	Yes	None	Yes
Isanti	8 tons	None	Yes	None yet	Yes
Itasca	12 tons	....	No	Pavement instead of gravel	Yes
Jackson	5 tons	None	Yes	Paving trunk lines	Yes
Martin	Few trucks	None	No	None	....
Morrison	5 tons	None	Yes	Gravel and concrete	....
Todd	3½ tons	....	Somewhat	None yet	....
Mississippi:					
Coahoma	12 tons	None	No	None	No
Missouri:					
Butler	1 to 6 tons	None	No	More permanent type	Yes
Callaway	6 tons	None	Yes	....	Need better surfaces
Clark	7 tons	....	No	....	Some hard surface
Harrison	1½ to 2 tons	....	No	None	....
Lincoln	4 tons	None	No	None	In the future
Miller	3 tons	None	Somewhat	Will change from earth to chert or gravel	....
Polk	3 tons	None	Yes	Thicker gravel surface	....
Montana:					
Granite	12 tons	....	....	....	....
Nebraska:					
Dakota	.....	None	Yes	None	....
Filmore	6 tons	None	Dirt roads	....	Contemplate permanent roads
Gage	4 tons	....	Yes	None	....
New Jersey:					
Burlington	15 tons	15 tons	Yes	Better foundation and surface	....
Gloucester	18 to 20 tons	....	Yes	Reinforce concrete and heavier pavements	....
Passaic	15 tons	15 tons	Yes	Thicker foundation; concrete roads 10 in. at center.	....
Salem	15 tons	....	Yes	From gravel to concrete	....
Somerset	12 to 15 tons	None	Several	None yet	Recommend
Sussex	8 tons	....	Yes	Trying to get concrete	....
New Mexico:					
Luna	5 tons	None	Yes	From 6"x12" gravel to 10"x18"	....
New York:					
Cayuga	9 tons	12½ tons	Yes	Increase thickness 25%, improve drainage	....
Dutchess	12 tons	None	Yes	8" to 18" sub-base	....
Franklin	8 tons	....	very much	Sub-base 6" to 12"	....
Herkimer	20 tons	None	Yes	None	Recommend load limit
Niagara	15 tons	....	Yes	Use brick and concrete	....
Orleans	8 tons	None	Very little	None	....
Saratoga	15 tons	None	Yes	Use concrete	....
Wayne	....	None	Yes	Heavier base	....
Yates	15 tons	8 on bridges	Yes	None	Weight should be limited
North Carolina:					
Davidson	5 tons	None	Sand-clay	....	Yes
Wayne	7 tons	5 tons	Yes	From gravel to concrete	....
Ohio:					
Guernsey	7 tons	800 lb. per in. of tire at 10 miles per m.	Yes	None	Yes
Highland	5 tons		Yes	Increase thickness	....
Huron	12 tons		Some	Concrete or monolithic brick	....
Madison	10 to 12 tons		Very little	Concrete and bit. concrete	....
Meigs	10 tons		Yes	Better foundation	....
Muskingum	15 tons		No	Thicker macadam	....
Wood	12 tons		Yes	Heavier foundation	....
Oklahoma:					
Bryan	3 tons	None	Yes	Something better than macadam or gravel	....
Craig	5 tons	5 t. at 15 mi.	No	Heavier bridges	....
Garfield	8 to 10 tons	....	Yes	Concrete replaces dirt	....
Harper	1 ton	....	Yes	....	Propose hard surface
Kingfisher	5 tons	....	....	Flattened grades, widened road	....
Major	4 tons	....	....	....	....
McClain	2 tons	None	Very little	....	No
Pennsylvania:					
Lebanon	10-12 tons	None	All macadam	Not yet	More hard-surface roads to distribute traffic
Mercer	11 tons	§None	Not seriously	Macadam to concrete	....
South Carolina:					
Florence	5 tons	"Reasonable"	Yes	Better drainage, thicker sand-clay surface	Change from sand-clay
South Dakota:					
Deuel	3 tons	None	Not much	....	....
Tennessee:					
Greene	7 tons	None	Yes	None	No
Haywood	1½ tons	None	No	None	No
Lewis	3 tons	None	No	None	No
White	3 tons	None	Not much	None	....
Texas:					
Castro	3 tons	....	Only chuck holes	None	No
Dallas	11 tons	....	Yes	Use more cement and bitumen	....
Frio	Army trucks	None	Yes	None	....
Lubbock	4 tons	None	Somewhat	None	....
Taylor	12 tons	None	Yes	Stronger bridges	....

PAVEMENT GUARANTEES

RESULTS OF HEAVY TRAFFIC—(Continued).

State and County.	Greatest weight of combined loan and truck using highways	Legal limit of weight	Have any roads been damaged by heavy trucks?	What changes have been made in road construction because of heavy trucks?	Are such changes contemplated or recommended?
Virginia:					
Greensville	3½ tons	....	Yes	None	No
Washington:					
Clarke	12 tons	12 tons	Yes	Make pavements heavier	....
Columbia	10 tons	None	Yes	None	....
Kittitas	7 tons	None	Gravel, in Spring	None	No
Lincoln	8 tons	7 tons	Yes	Will use more gravel, and hard surface on some	....
Pend Oreille	3 tons	400 lb. per in. tire width	Somewhat	None	No
Pierce	12 tons	....	Yes	None	....
Skamania	8 tons	None	Yes	....	Limit loads
Spokane	10 tons	10 tons	Yes	Require 5" concrete instead of asphalt base under asphalt pavement	....
West Virginia:					
Fayette	7 tons	600 lb. per in. tire width	No	None	....
Hancock	12 tons	15 tons	Yes	Heavier base	....
Harrison	10 tons	600 lb. per in. tire width	Yes	All concrete foundations	....
Monongalia	14 tons	600 lb. per in. tire width	All paved before 1917	Heavier roads and foundations	....
Raleigh	3 tons	600 lb. per in. tire width	No	Increase foundation stone to 8"	....
Webster	No trucks	15 tons	No	None	No
Wisconsin:					
Adams	3 tons	None	No	....	Yes
Forest	....	None	....	Graveling	....
Grant	8 tons	None	Yes	Heavier, more permanent roads	....
Jefferson	5 tons	None	Not much	None	Recommend concrete
Juneau	3 tons	None	No	None	No
Outagamie	7 tons	None§	No	Concreate instead of macadam	....
Sauk	11 tons	Bridge, 15 tons	No	Not yet; concrete and tar macadam in 1921	....
Washburn	5 tons	None	Not much	Widening roadway	....
Wyoming:					
Platte	5 tons	None	No	None	No

*Only one truck of over 4 tons uses roads. †5-ton limit legislation contemplated. §Legislation pending.

PAVEMENT GUARANTEES.

State and County.	Are highway contractors required to give bonds?	Period of guarantee.	"Do you consider guarantee desirable for all kinds of pavements?"	If not for all for what kinds?
Arkansas:				
Hempstead	....	....	Yes	....
Little River	Yes	2 or 3 years	No	Where gravel or base is bad
California:				
San Benito	No	....	....	....
Florida:				
Citrus	Yes	1 year	Yes	....
Lake	No	....	No	Only asphalt
Georgia:				
Chattahoochee	Don't contract	....	....	....
Liberty	No contract work except bridges	4 to 10 years	Yes	....
Illinois:				
Dewitt	Yes	....	....	....
Marshall	No	....	No	None
McHenry	No	....	No	Asphalt
Stephenson	No	....	No	....
Washington	No	....	....	....
Whiteside	No	....	....	....
Williamson	No	....	No	Bituminous macadam
Winnebago	No	....	No	None
Woodford	Yes	To satisfactory completion of work	No	....
Indiana:				
Adams	Yes	1 year	Yes	....
Dubois	No	....	No	Concrete, wood block or brick
Hancock	Not yet; recommended it	....	No	Brick, concrete & perhaps others
Howard	Yes	10 years	Yes	None
Jackson	No	None	No	For all hard surface
Marion	Yes	5 years	No	....
Randolph	No	....	....	Hard surface only
Tippecanoe	Yes	5 years	....	None
Tipton	No	....	No	None
Vigo	Sometimes	5 years	No	None
Wayne	No	None	No	....
Iowa:				
Adams	....	....	....	When contractor uses own specifications
Appanoose	....	5 years	Yes	....
Cerro Gordo	No	....	No	....
Fayette	Yes	....	....	....
Humboldt	Yes	3 years	Yes	....
Ida	No	....	....	....
Mahaska	Grading contractors	1 year	Yes	....
Mills	....	....	....	Asphalt, bitulithic and similar types
Muscatine	In City of Muscatine	5 years	No	All asphaltic Concr. & asphalt
Osceola	....	....	Only part	....
Palo Alto	Not yet	5 years	No	....
Tama	Yes	....	....	....
Kansas:				
Anderson	Yes	....	Yes	....
Allen	Yes	Not determined	Yes	....
Chase	No	....	No	....
Doniphan	Yes	....	No	Concrete, asphalt and brick
Douglas	Will be required	Not determined	Yes	....
Labette	Yes	....	....	....
Ness	Yes	5 years	....	....
Sedgwick	No	....	No	....
Wilson	No contracts	....	....	....
Kentucky:				
Henderson	No	....	No	No kind
Menifee	Yes	1 year	....	....
Morgan	Yes	Varying	Yes	....

PAVEMENT GUARANTEES—(Continued).

Kentucky (Continued):				
Nicholas	No	....	No	Asphalt, brick & sometimes concr.
Louisiana:				
Jackson	Yes	....	Yes	....
Maryland:				
Allegany	No	....	No	....
Anne Arundel	Only on patented pavement	5 years	No	Only patented pavements
Kent	....	Until work is completed	No	....
Talbot	No	....	No	In no case
Wicomico	Only on State work	....	....	....
Michigan:				
Berrien	On brick	5 years	No	Brick & asphalt
Cass	No	....	No	None
Ingham	No	....	No	....
Kalkaska	Yes	10 years	Yes	....
Macomb	On concrete and asphaltic concrete	1 to 5 years	No	Concrete & asphaltic concrete
Minnesota:				
Goodhue	No	....	....	....
Isanti	Yes	Not determined	....	....
Itaska	No	....	No	None
Morrison	On all contracts	Until work is completed	Yes	....
Mississippi:				
Coahoma	Yes	Engineer's discretion	Yes	....
Missouri:				
Callaway	On work by special road districts	Until work is completed	....	For better types
Harrison	Yes	....	No	Streets, public highways
Lincoln	No	....	....	....
Polk	....	....	....	....
New Jersey:				
Burlington	Maintenance	1 year	No	None
Gloucester	For faithful performance of contract	Until final acceptance	Yes	....
Passaic	For faithful performance of contract	1 to 2 years	Yes, not over 2 years	....
Salem	Yes	1 year	Yes	....
Somerset	No	....	No	Asphalt
Sussex	Under state aid specifications	1 year	No	None
New Mexico:				
Luna	....	....	Yes	....
New York:				
Cayuga	Work by force account	....	....	....
Dutchess	Work by town labor	....	Yes	....
Herkimer	Yes	Until completion of work	....	....
Niagara	No	....	No	None
Saratoga	Yes	3 yrs. for brick, none for concrete	No	None
Wayne	Work by force account	....	No	....
Yates	Work by county	....	Not where specifications are controlling	None
North Carolina:				
Davidson	Yes	2 years	Yes	....
Wayne	Yes	5 years	....	....
North Dakota:				
Divide	Yes	Until completion of work	....	....
Ohio:				
Guernsey	No	....	Yes	....
Highland	No	....	No	Hard surface
Huron	No	....	....	....
Madison	No	....	No	None
Meigs	Yes	....	....	....
Muskingum	No	....	No	....
Wood	No	....	No	None
Oklahoma:				
Bryan	No	....	No	....
Craig	Yes	5 to 10 years	No	Concrete & brick
Garfield	Yes	5 years	No	Bituminous
Harper	Yes	To completion of work	Yes	....
McClain	Yes	Until work is complete	....	....
Pennsylvania:				
Lebanon	Work by force account	....	....	....
Tennessee:				
Greene	No	....	No	None
Haywood	No	....	....	....
Lewis	Yes	Until contract is finished	Yes	....
White	No	....	....	....
Texas:				
Castro	....	....	Yes	....
Dallas	No	....	No	Any kind, under certain conditions
Taylor	No	....	....	Not for gravel roads
Virginia:				
Greensville	Yes	....	....	....
Washington:				
Clarke	No	....	No	Concrete bitulithic & asphaltic concr.
Columbia	Yes	Until work is completed	....	....
Kittitas	Macadam, no; bituminous, yes	....	No	Brick, bituminous
Lincoln	No	....	No	....
Pend Oreille	No	....	No	....
Pierce	No	....	No	None
Skamania	Yes	Till work is accepted	Yes	....
Spokane	No	....	No	None
West Virginia:				
Fayette	No	....	....	None
Hancock	No	....	No	None
Harrison	No	....	No	....
Monongolia	No	....	No	None
Nicholas	Work by day labor	....	....	....
Raleigh	Yes	....	....	....
Webster	No	....	....	....
Wisconsin:				
Forest	No	....	....	....
Grant	Yes	Until contract is completed	Yes	....
Jefferson	Yes	Until work is finished	....	....
Outagamie	No	....	No	Only sheet asphalt
Saulk	Yes	Till final acceptance	No	Concrete
Washburn	Work by day labor	....	....	....

CONTRACT WORK.

State and County	Form of contract that is favored	Is there abundance of unskilled labor in county?	Wages paid this year	Wages prior to 1917
Arkansas				
Hempstead	Straight contract	Yes	$2.50	$1.50
Little River	Straight contract	No; will be in 30 days	25c to 35c	15c to 20c
California:				
San Benito	Straight contract	No	$3.00 to $3.50	$2.00 to $2.50
Florida:				
Citrus	Day labor	Yes	$2.00 to $3.00	$1.25 to $1.50
Lake	Straight contract	No	$2.00 to $2.50	$1.25 to $1.75
Lee	Straight contract	No	$2.50 to $3.00	$2.00
Georgia:				
Laurence	.....	No	....	....
Liberty	Contract work, contractor to furnish all material	No	$2 and up	$1.00 to $1.50
Illinois:				
Christian	Contract	Yes	40c	25c
De Witt	Contract	No	25c to 50c	30c
Marshall	Contract, authorities furnishing material; or cost plus percentage	No	30c to 36c	25c
McDonough	Straight contract on concrete bridges and S. A. R. work; day labor on oiled earth roads	No	$3.50	$2.75
McHenry	.....	No	40c	$2.00 to $2.50
Stephenson	Straight contract, but protect contractor on freight rates	Sufficient	$3.50 to $4.00	$2.00 to $2.50
Washington	Contract	Yes	$3.00 to $3.50	$2.00 to $2.50
Whiteside	County furnish materials, contractor do work	Plenty	35c to 45c	20c to 25c
Williamson	Contract, material furnished by county	Yes	50c to 75c	25c to 40c
Winnebago	.....	No	50c	40c
Woodford	Straight contract	No	30c to 40c	20c to 30c
Indiana:				
Adams	Straight contract	Yes	25c	about 17½c
Dubois	Straight contract	Yes	$2.75 to $3.00	$1.50 to $2.00
Hancock	Straight contract	Yes	35c	20c
Howard	Straight contract	No	$3.00 to $4.00	$2.00 to $2.50
Jackson	Contract, county furnishing materials	Sufficient	30c to 40c	20c
Marion	Straight contract	Yes	38c	$2.25 to $2.50
Randolph	Straight contract	No	30c to 40c	25c to 30c
Tippecanoe	Straight contract	Yes	25c to 30c	25c
Tipton	Cost plus definite profit	No	30c to 50c	20c to 27½c
Vigo	Straight contract	Yes	$3.00 to $3.50	$1.50 to $2.25
Wayne	Straight contract	No	40c	27½c to 30c
Iowa:				
Adair	All work done by day labor	....	35c to 42½c	27½c to 37½c
Adams	Local conditions favor day labor	Will be shortly	40c	35c
Appanoose	Straight contract	Yes	$3.00 to $3.50	$2.50
Bremer	Day labor	No	$3.00	$2.00
Cerro Gordo	Contract, county furnishing material	No	40c	30c
Cherokee	Straight contract	No	40c to 45c	27½c to 35c
Fayette	Day labor cheapest if right men at the head; otherwise contract	No	40c	30c
Humboldt	Straight contract	Not if we carry out program	$3.50 or $4.00	About $2.75
Ida	Day labor on concrete work, if foreman competent	Yes	45c	25c
Jasper	Day labor	Yes	$4.00 to $5.00	$2.50 to $3.00
Johnson	Straight contract	Yes	40c	25c to 30c
Kossuth	Straight contract	Plenty	50c	30c
Lee	Day labor	....	$3.50 to $4.00	$2.50
Lyon	Straight contract; day labor on small work	Enough	$4.00 to $6.00	$3.00 to $4.00
Mahaska	Straight contract	Not at present	$3.00	$2.50
Mills	Straight contract and day labor	Yes	35c	25c to 30c
Muscatine	Straight contract	No surplus	30c to 40c	25c to 35c
Osceola	All to suit variable conditions	Yes	25c to 40c	20c to 30c
Iowa (Continued):				
Palo Alto	Road work by contract; bridge work by day labor	Not an abundance	$4.00 to $5.00	$2.50 to $3.00
Sac	Straight contract	Not an abundance	$4.00	$2.75 to $3.00
Tama	Straight contract	Plenty at present	35c to 45c	30c
Kansas:				
Allen	Contract, county furnishing labor	Rather scarce	40c	25c
Anderson	Straight contract	Yes	25c	20c
Chase	Straight contract	Yes	40c to 50c	30c
Doniphan	Straight contract; small jobs by day labor	No	$3.00	$2.00
Douglas	Straight contract	Yes	$2.50 and up	$1.50 to $2.00
Kingman	County furnishing material, or cost plus	Yes	35c	25c
Labette	Straight contract	Yes	$2.00 to $2.50	$1.50 to $2.00
Meade	Day labor	No surplus	....	....
Ness	.....	Yes	40c	25c to 30c
Republic	Contract, county furnishing material	Scarce	$2.50 to $3.00	$2.00 to $2.50
Rooks	Day labor	Yes	40c	30c
Sedgwick	Contract, county furnishing material; some cases, day labor	Fair supply	$3.50 to $4.00	$2.00 to $2.50
Wilson	Force account	No	35c	25c to 50c
Kentucky:				
Greenup	Straight contract	Yes	$1.75 to $2.25	$1.50 to $2.00
Henderson	Straight contract, also county labor	Yes	$2.00 to $2.50	$1.50
Menifee	.....	No	$2.00	$1.50
Morgan	Day labor	Yes	$2.50	$1.50
Nicholas	Day labor, 1st; straight contract, 2nd	No	$2.50 to $3.00 (10 hours)	$1.50 to $1.75
Oldham	Contract work	No	$2.00 to $3.00	$1.50 to $2.50
Louisiana:				
Parish of Caddo	Force account	No abundance or shortage	$2.50	$1.75 to $2.00
Jackson	Straight contract	Yes	$2.00 to $3.00	$1.25 to $1.75
West Feliciana	Straight contract; cost plus is all right	Yes	$1.50	$1.00
Maryland:				
Allegany	Cost plus a definite profit	No	$3.00 (8 hours)	$2.00 (9 hours)
Anne Arundel	Straight contract; day labor for repairs and small work	Scarce last year, getting more abundant	$2.50 to $3.00	$1.50
Kent	Straight contract or day labor	No	$2.50 to $3.00	$1.75
Talbot	Straight contract for new work; day labor for maintenance	No	27½c	16 2/3c
Wicomico	Under $100,000, day labor; over that, straight contract	Sufficient	$2.00 to $2.25	$1.50 to $1.75
Michigan:				
Berrien	Straight contract	Will be shortage when work all started	35c to 40c	$2.75 (10 hrs)
Cass	Cost plus definite profit, and day labor	No	$3.50	$2.00 to $2.50
Ingham	Day labor	Generally, yes; some places, no	$3.00 (10 hrs.)	$2.25
Kalkaska	Day labor	No	$2.75 to $3.00	$1.75 to $2.00
Macomb	Straight contract, also county furnishing material	At present, yes	40c to 45c	25c to 30c
Menominee	Day labor	No	$2.50 to $3.00	$1.75 to $2.00
Minnesota:				
Blue Earth	All day labor	Yes	40c	25c to 30c
Cottonwood	Day labor, county furnishing material	Yes	30c to 40c	....
Crow Wing	....	Yes	35c	27½c to 30c
Goodhue	Straight contract	No	$3.00	$2.50
Grant	Straight contract	No	35c	25c
Isanti	Straight contract, 1st; county crew, 2nd	Yes	35c	30c

CONTRACT WORK (Continued)

State and County	Form of contract that is favored	Is there abundance of unskilled labor in county?	Wages paid this year	Wages prior to 1917
Minnesota— (Continued)				
Itaska	Straight contract	No scarcity	$3.50	$2.25
Jackson	Day labor; contract work by cost plus percentage	No	45c	$2.75 to $3.00
Martin	$80,000 to be done by day labor; $120,000 by contract	No	$40 to $60 per month	$40 per month
Morrison	Straight contract, county furnishing material	Not last year	$3.00	$2.00
Roseau	Straight contract, county crews on standard culverts and small bridges	Yes	30c to 35c	30c to 35c
Todd	Day labor	....	....	....
Mississippi:				
Coahoma	Contract, county furnishing material	Fair	$1.50 to $3.00	$1.25 to $2.00
Missouri				
Butler	Straight contract	No	25c to 50c	20c to 40c
Callaway	Straight contract	No	About 30c	About 20c to 25c
Clark	Straight contract	Average conditions	30c	20c
Harrison	.....	Yes	$3.00 (10 hr.)	$2.00 to $2.50
Lincoln	Straight contract, but operate under force accounts	No	$2.50 to $3.00	$1.25 to $2.50
Miller	Force account, with good foreman	Yes	$2.00 to $3.00	$1.50 to $2.00
Polk	.....	Yes	$2.00	$1.20
Montana:				
Granite	Straight contract	Plenty	$4.00	$3.00 to $3.50
Nebraska :				
Dakota	Not decided	No	$4.00	$2.50 to $3.00
Fillmore	Cost plus percentage profits	No	$3.50 to $4.00 (10 hrs)	$2.00 to $2.50
Gage	Day labor	No	35c to 50c	20c to 30c
New Jersey:				
Burlington	Contract	Yes	$3.00 (9 hrs)	$1.75
Gloucester	New construction and extensive resurfacing by contract; small work by force account	Not at present	38c to 40c	38c
Passaic	Straight contract	Sufficient	$3.00 to $3.50	Less than $3
Salem	Straight contract	Yes	$3.50	$2.50
Somerset	.....	Fair amount	$3.75 to $4.00	$1.85 to $2.25
Sussex	Straight contract, and day labor	Sufficient	—33 1/3c	25c
New Mexico:				
Luna	By county	Yes	$1.50 to $2.50	$1.00 to $1.25
New York:				
Cayuga	Day labor	Expect to get enough	$2.50 to $4.00	$2.00 to $3.00
Dutchess	Day labor	Fair amount	$2.50 to $3.50	$2.00 to $2.50
Franklin	Day labor	Yes	$3.00	$2.00
Herkimer	Straight contract	No	$4.00	$1.75
Niagara	Day labor, if plant available, otherwise straight contract	Not now, but in prospect	35c to 40c	25c to 32c
Orleans	.....	No	27½c to 40c	20c to 30c
Saratoga	Straight contract	Fair amount	30c to 40c	20c to 25c
Wayne	Day labor	Sufficient	$3.00 (10 hrs)	25c
Yates	Day labor	No	30c	20c
North Carolina:		No	$2.50	$1.50
Davidson	Contract, county furnishing material	No	$2.50 to $3.00	$1.25 to $1.50
Wayne	Straight contract and county work with prison labor			
North Dakota:				
Divide	Straight contract	Yes	About $3.00	$3.00
Ohio:				
Guernsey	Straight contract	Not now	$3.00	$1.75 & $2.00
Highland	Straight contract	No	$2.50 to $3.00	$1.50 to $2.00
Huron	Straight contract	Fair supply	$3.50	$2.50 to $2.75
Madison	Straight contract	Yes	35c to 37½c	20c to 25c
Meigs	Straight contract	Fair number	$2.50 to $3.50	$2.00 to $3.00
Muskingum	Straight contract	Yes	$3.00 to $3.50	$3.00 to $3.50
Wood	Straight contract	Yes	40c	30c
Oklahoma:				
Bryan	Cost plus	Limited amount	$2.50 to $3.00	$2.00
Craig	Straight contract	No	50c	25c
Garfield	Contract; or contract, county furnishing materials	Sufficient	45c to 50c	30c to 35c
Harper	Straight contract	Except in harvest time	$3.00 and up	$2.00
Kingfisher	Straight contract or day labor	No	40c to 50c	25c to 35c
Major	Contract, county furnishing material	Not too many	30c to 45c on bridge work	20c to 35c on bridge work
McClain	Straight contract	Yes	$3.00	$2.00
Pennsylvania:				
Lebanon	.....	Very much so	2.75 (10 hrs)	$2.25 (10 hrs)
South Carolina:				
Florence	.....	No	$1.50 to $2.00	$1.00 to $1.50
South Dakota:				
Deuel	Straight contract	Fair	$4.00	$2.75 to $3.00
Tennessee:				
Greene	Straight contract	Sufficient	$1.50 to $3.00	$1.25 to $2.50
Haywood	.....	Yes	$2.00 to $3.00	$1.00
Lewis	Day labor	No	$2.50 to $3.25 (10 hrs.)	$1.25 to $1.50
White	Day labor	Yes	Average $2.00	$1.50
Texas:				
Castro	Contract; but work done by day labor	No	$3.00	$1.50 to $2.00
Dallas	Straight contract, except for cement and asphalt	Moderate supply	$2.50 to $3.00	$1.75
Frio	.....	Yes	$1.50 to $3.00	$0.75 to $1.50
Lubbock	.....	Yes	$3.00 to $4.00	$3.00
Taylor	Straight contract	No	$2.50	$1.50
Virginia:				
Greensville	Day labor at present	Yes	$2.00 to $3.00	$1.00 to $1.50
Washington				
Clarke	Straight contract on unit prices	Moderate supply	$3.50 to $4.00	$4.00 to $4.50
Columbia	Straight contract	No	$3.00 to $5.00	....
Kittitas	Straight contract for difficult work; day labor otherwise	Yes	$3.50	$2.25
Lincoln	Straight contract	Yes	$3.50 to $4.00 (8 hrs)	$2.75 to $3.00
Pend Oreille	Lump sum contract	Enough	50c	25c
Pierce	Contract	No shortage	$4.00 to $5.00	$2.00 to $3.50
Skamania	Day labor, where there is necessary equipment	No	$3.50	$2.50
Spokane	Lump sum contract	Yes	$4.00	$3.00
West Virginia:				
Fayette	Straight contract	Yes	$30c	20c to 25c
Hancock	Straight contract, county buys brick	No	$3.60 to $4.00	$1.75 to $2.00
Harrison	Straight contract, county furnishing material	Average	$3.50 to $4.00	$2.50
Monongolia	Day labor	Yes	33 1/3c	20c to 25c
Nicholas	.....	Not now	$3.00 to $4.00	$2.00 to $2.50
Raleigh	Straight contract, county furnishing certain materials	Good supply while coal mines closed	30c	20c to 27½c
Webster	Straight contract	No	$3.00	$1.50 to $1.75
Wisconsin:				
Adams	Day labor	No	30c	20c
Forest	.....	Yes	$3.50	$2.00 to $2.25
Grant	Contract on some jobs, day labor on others	Hardly enough	$3.00 (10 hr)	$2.50
Jefferson	Straight contract	No	30c	27½c
Juneau	Day labor	Yes	$3.00	$2.00
Outagamie	Straight contract, county furnishing material.	Sufficient	$3.75 average	$2.50
Sauk	Straight contract and day labor by county	Plenty	30c	25c
Washburn	Day labor at present	Yes	25c to 30c	....
Wyoming:				
Platte	Straight contract with rigid inspection	No	$4.00	$2.50

NATIONAL ROADS

Argument in Their Favor Based on Success of National Administration of French Roads—Necessary for Interstate Routes.

By MAJOR E. A. KINGSLEY, Engr., U. S. A.*

The following appeal for national highways, with its arguments in favor of them based upon French practice and experience, was suggested to the author, we suppose, as being especially timely in view of the agitation for a national system on the part of some good roads advocates and the adoption by the American Road Builders' Association last February of a committee report advocating a national highway system and the establishment of a national highway commission to control the same. The local applications at the end of the article bring the arguments right home to the U. S. A.

In the early days of America, before the railroads or steamboats and long years before the automobile, the government undertook the building of national roads. Roads were necessary for the development of the new country and roads were planned to be built with government funds, by the government and for the people. The people could not build the through roads planned because of the expense. There were but few people to share this expense.

The most notable example of government built road was the old National Road from Cumberland, Md,, west to the Mississippi river. This road crossed the heart of the new country through Mayland, what is now West Virginia, Ohio, Indiana and Illinois. But before its completion, railroads came into use and in the national government's anxiety to aid in railroad construction, roads, as a national issue, were entirely forgotten.

Then came to the front the old and oft-abused "Doctrine of States Rights" and the war of 60-65. During the reconstruction period roads were but little thought of. The South had to recover from its terrific loss, and the North was heavily in debt and busy recovering from the drains of war.

The advent of the bicycle in the early nineties did a little toward making for better roads, but the bicycle influence was local only and largely in the vicinity of the cities and the towns. The bicycle craze was wellnigh universal, but it did not create sufficient sentiment to insure either permanent or national roads.

There is no question but that the automobile invention and perfection has done really more to increase the good roads fervor than any other single thing. Many other conditions and circumstances have combined to cause good roads agitation, but the automobile has created long-distance travel and an actual demand for roads that must be met.

Many of the states have gone forward and have adopted a more or less general plan for state roads. Some of these states have made wonderful progress on their state road systems. But the efforts to nationalize the roads have been confined to organizations and societies with no authority to act. All that could be done was to urge the various states, counties and towns to improve the roads systematically. These efforts have resulted in more or less success at times, but have more often resulted in failures.

The United States Government made a big advance toward better roads and in the direction of national roads, when, in 1916, the Federal Aid law was passed. This law was an incentive to the states to create the necessary road laws to obtain their portion of the appropriation for new roads. And it wisely required government supervision, insuring a more or less uniform method of construction. It was a tendency toward centralization and certainly a step in the right direction. It was only a step, however.

To the 2,000,000 men who have been in France and have seen the net work of roads in every community and extending in every direction the question will arise, "How can we in America get such highways?" The soldier who has traveled over the French roads will return to his farm or his town to cry for roads. He will not be content to drive through the mud, for he has seen what can be saved in time and money by having good roads.

Not only is the returning soldier going to want roads for himself. He will go home demanding great arteries of travel such as he has seen in France. They have shown him that France has prospered and profited by them in times of peace and that France was saved by them in times of war. He knows only too well that many many days and weeks while he was at the front the railroads could not feed him. Trucks by the thousands carried provisions to him because they could reach him in no other way. Without these roads how often would he have been hungry!

In some states a system of through highways can be built, but in many of our states this system must be a makeshift or not built at all. Most of our southern and western states could not entertain the thought of expense of building permanent roads across the state. The expense would be far greater than the state could bear. Then, too, the question of politics and jealousies would enter into the location and each state would look to its own (supposed) advantage regardless of the adjoining state. The result would be, as we now see it, a system of state roads built for the benefit of the state and its citizens only.

In its government, France is more nearly like one of our states than our nation, and the smaller political divisions, termed departments, are somewhat similar to county governments. The roads, too, are divided into two general classes, termed by the French respectively as "routes national" and "routes vicinal."

The latter class, "routes vicinal," are strictly departmental. They are again divided into several classes, but they are built at the expense of the department and so maintained. Each department has its chief of the road service, the "agent voyer en chef." He reports to the ministry of the interior and operates as a departmental officer. The roads are laid out and built as local roads, with reference to the local of the community. No attention is paid to securing short distances through, for they are not through roads. The three classes are well built and well maintained, but they are built and maintained entirely for the community. They are the real market roads. These are the roads over which the peasant woman carries her geese, her butter and her eggs to the market. And these are the roads over which the wood for fuel and the wine, the French staff of life, are carted.

The "routes national," as the name implies, are the state or national roads. They are built by the state (government of France), and they are maintained by the state. They are selected routes between two points often passing through many departments. No attention is paid to departmental lines in laying out the "routes national." Only the question of service to the greatest number of people or benefit to the state is thought of.

*Superintendent of Roads, Intermediate Section (East), A. E. F., France. Major Kingsley has been Superintendent of Roads at Nevers, France, since January, 1918, having charge of the maintenance of nearly 500 miles of the main lines of communication for the American Army in France and the construction and maintenance of nearly as much road mileage in addition on projects and to and from various centers of American Army industries.

The chief of the service of the "routes national" is in Paris, and reports to the Minister of Public Works. In each department of France he has an engineer chief, the "engineer des ponts et chaussees," who has direct charge of construction and maintenance. All of the "roads national" within the limits of his department come under the supervision of this "engineer des ponts et chaussees."

Often times, to shorten the distance of the road, these routes national pass within a few kilometres of good-sized towns and villages, but do not deviate from the "straight" path. The towns will be connected with the route national by departmental roads. As an illustration, Etang, a good sized and important town, is 4 kilometres from route N. 73, connecting therewith by means of G. C. 61. N. 73 is the national road to Northeast France from Moulins. Only a few miles additional would have taken it to Etang. Also, the very important city and famous watering place, Vichy, is but 26 kilometres off of N. 7. But N. 7 is the great highway from Paris south through Nevers, Moulins and Lyon to Southeast France, and, as to pass through Vichy would have lengthened the line considerably, Vichy is served from N. 7 by departmental roads.

The routes national are built under the direct supervision of the engineer des ponts et chaussees. The specifications are furnished from the office of the chief of the service, the "chef due service des routes," in Paris. And the construction methods are the same for all. It matters not whether the roads pass through the rich Burgundy country in the department Cote d'Or, down the valley of the Saone in the department Saone et Loire, through the rich valley of Rhone, or through the rough and poor mountain districts. It is a national route to connect two distant points, and the road construction is uniform. The maintenance is as carefully looked after in one section as in another, whether the section is a rich or a poor one.

The line in France from Tours, a city of about 100,000, to Dijon, a city only slightly smaller, is but a few miles shorter than from Dallas to San Antonio, Texas, cities nearly the same size. The French cities are connected (or were before American truck traffic wore out the macadam) by a splendid national highway. The width, the contour, the surface and all were the same through the various departments.

Connecting Dallas and San Antonio is also a highway. At least there is a highway located between the two cities. It starts from a paved thoroughfare in Dallas and is gravel, macadam, bituminous construction, and even a dirt road, depending upon the section through which you travel, before reaching San Antonio. In summer it is very dusty and in wet weather is impassible in spots. It is not a "route national." The road for a few miles passes through the corner of a certain county, but through no town in that county, and because it was of no direct benefit to the county seat, but of more direct benefit to the next county, the commissioners refused to bear any part of the cost of even grading and graveling the short stretch.

This is but one example. Thousands exist in other sections. Millions of dollars is annually paid as a tax to such a fallacy in light loads and broken vehicles. Even government aid has failed to stop it. True, more roads and better roads are being built and state supervision and construction are being encouraged, but it does not go far enough.

Wyoming can hardly afford to build a great paved highway through the state connecting Salt Lake City and Minneapolis. Colorado and New Mexico would be too reavily taxed to connect, with a permanent pavement, Denver and El Paso, and, besides, El Paso is in Texas. The legislators of Louisiana, Mississippi, Alabama and Georgia who voted money for a permanently paved road from New Orleans to Atlanta would escape hanging by only an inch.

Such roads are rightly national roads. They are for the benefit of all the people. New York and San Francisco are interested. And more than all is the nation interested. Military movements require good roads, for the present-day army is motorized. Everything moves by motor power. Without the motor the modern army cannot exist. All the people must contribute to the cost of national roads, and all the country will benefit by the national system. State and national aid is good and should continue, but a system of paved national roads built and maintained by the government as are the roads of France is the present need and the immediate and urgent need of the United States.

DEVELOPMENTS IN BRICK PAVING.†

Construction with Sand Cushions, Cement Mortar Beds, and Green Concrete Foundation.

By MAJOR WM. M. ACHESON.*

Brick pavement construction since 1915 has been subject to far greater changes in design than any other pavement. These changes, through a more rational use of the same amount of material, have tended to greater strength and durability. In this paper it is the intention to describe the three different types of pavement or I might say the old and the new methods, and point out the advantages and disadvantages of each.

FOUNDATION COURSE.

The foundation course is usually made of cement concrete and in general a 1-2½-5 or 1-3-6 mixture is specified, the thickness depending largely upon the character of the subsoil and the amount of the traffic. While the cement-concrete foundation predominates in brick pavement construction, many miles have been laid on foundations of compact sand, gravel and broken stone. Engineers will agree with me in the absolute necessity and economy of concrete as a foundation for brick and all types of block wearing surface, together with mixed types of bituminous pavements. In fact, to my mind, the time is here when highway engineers are called upon to design rigid types of construction to meet the demand of modern traffic, which means the development of heavy motor-driven traffic.

Engineers are now giving special attention to the different parts of a pavement in order to meet existing conditions. Metal reinforcement is sometimes specified to be imbedded in the concrete foundation over soft places and recently dug trenches. By this it is hoped to prevent the cracking which, in the majority of cases, comes from the condition of the subsoil acting through the base upon the surface of the pavement. Experience has shown that an evenly built foundation which conforms to the finished cross-section of the road will result in a uniform thickness of sand cushion and a smooth wearing surface. In this pavement, as in all other pavements, the key to the whole situation is the condition of the subsoil and the foundation, and in this phase too great care cannot be exercised from the design or construction standpoint.

SAND CUSHION.

Brick pavements with a sand cushion or a bed course of plain sand have been built since the first brick pavement constructed in 1870, and represent at the present time by far the larger percentage of the three types. The thickness of the sand cushion called for in the older

*Division Engineer, State of New York.
†Paper before America Road Builders' Association.

specifications in constructing this type of pavement has been considerably greater than is advocated by most engineers at the present time. The theory advanced in behalf of the sand cushion is that it serves the double purpose of providing a uniform bearing for the wearing surface and supplies resiliency under traffic. With this in mind, specifications called for a sand bed not less than two inches in thickness.

Many of these cushions were not given the proper care in constructing and were formed by screeding out the full thickness at one time without the necessary consolidation by hand rolling. This was responsible for failures in the brick wearing surface which engineers traced directly to the non-uniformity of the sand bed. An effort was made to correct this in later specifications by calling for a sand cushion of not over one inch in thickness, together with requirements as to its gradation by sieve analysis and the amount of loam permissible in the sand used.

New York State specifications for the bed sand required a sand of which 100 per cent passes a No. 6 sieve and not over 90 per cent through a No. 20 sieve. "An excessively fine sand will not be accepted in this class. Sand may be rejected if it contains more than 15 per cent of loam and silt," which amount was deemed advisable for proper compacting.

Present day specifications describe carefully the manner of forming or building up the sand bed by screeding it in layers and rolling the same in order to form as nearly as possible a uniform bearing for the wearing surface.

Notwithstanding all the precautions and refinements of the later specifications where a sand bed is used, it has been shown that the defects are not overcome in the wearing surface, because it is impossible to properly compact a sand bed varying in moisture content and thickness. Also, a wet sand cushion when dried out will shrink and leave hollow spaces, consequently defeating its function of providing a firm and uniform bearing at all times for the wearing surface. Another defect of the sand cushion is that it works up into the joints of the brick and prevents the joint filler from thoroughly penetrating and properly bonding the wearing surface. In the repairing of many of our brick roads I have seen defects in the surface caused by the sand cushion coming up into the pavement at least 2½ inches.

WEARING SURFACE.

The wearing surface of the pavement is composed of vitrified paving brick joined together with a filler. Smaller bricks were used in the early manufacture for brick pavements and without lugs. Later, in order to obtain a unifom width of joint to take the filler, the bricks were made with lugs by repressing. The standard paving brick of today is 3½ inches in length by 4 inches in depth, laying 40 brick to the square yard. These brick are larger than the first brick manufactured.

The wire-cut lug brick came into vogue in 1910, the first wire-cut lug bricks being used by the New York State Commission of Highways in the construction of the Williamsville road near Buffalo. These brick have steadily increased in favor with paving engineers and are now universally called for. The experience of New York State with the wire-cut lug brick has been that it possesses uniform lugs and fiber sides, due to the method of manufacture. The fiber sides which are always obtained in a wire-cut brick give a greater bond strength at all times, while the uniform lugs insure a thorough and even penetration of the filler, and from a construction standpoint provide parallel joints, which means better construction. The square edge of a wire-cut brick in addition means a flush joint, which produces at all times a smooth wearing surface and one which will not cobble under traffic.

Two classes of joint filler are used to bond the brick units together, the cement grout filler and the bituminous filler. My experience and observation are that the results from the cement grout filler are superior and more durable than those from the soft filler and one which is absolutely necessary in the modern semi-monolithic and monolithic types of construction. If soft filler is used, the old sand bed is more likely to be the design. New York State specifications for cement grout filler allow the use of grout made of one part cement and two parts of grout-sand if machine mixed, and a grout made of one part Portland cement and one part grout-sand, if hand mixed. In general, the specifications of today call for a grout made of one part cement to one and one-half parts of sand. Machine-mixed grout is, in the opinion of most paving engineers of today, far superior to hand-mixed and at the same time is more economical in manipulating. Paving engineers recognize the necessity and importance of the grout filler and are taking every precaution in the selection of the materials and their application.

BRICK PAVEMENTS WITH CEMENT-SAND BEDS.

Experience and observation have demonstrated that many failures in the wearing surface are due to the sand cushion, which engineers have endeavored to combat. The solution of this factor has been the development of the cement-sand bed, which provides a non-shrinking, rigid super-foundation, thus making the first step toward a brick monolithic type of construction. Brick pavements constructed with a cement-sand bed are commonly known as semi-monolithic construction, and from this type developed the true brick monolithic construction which is now being used by highway engineers. The semi-monolithic type is the same as other brick pavements constructed with sand cushions, except that a mixture of sand and cement, containing generally one part Portland cement to three parts sand, is substituted for the sand cushion. It is the practice to thoroughly mix these materials dry by machine in the proportions specified. The mixture, when spread out, should be screeded with a template cut to the required contour of the finished pavement. Care should be taken to get uniformity, but hand rolling is not deemed advisable as it has been learned that a rolled cement bed does not insure a smooth wearing surface due to its great density. With an unrolled surface the brick as laid is always bedded in the cement-sand super-foundation. The thickness advocated in general is a minimum of ¾ inch and a maximum of 1 inch. It is my practice to wet the cement-sand bed with a sprinkling can just ahead of laying the brick. Immediately preceding the grouting, the brick surface should be thoroughly wet. All precautions should be taken in the mixing and the application of the grout filler.

With present methods, the semi-monolithic type of construction is better adapted to wide street construction than the monolithic.

The advantages of semi-monolithic construction are that it overcomes the defects of the sand cushion by insuring rigid construction in that it practically unites the wearing surface with the concrete foundation. The cement-sand cushion at all times provides a perfect bond for the full depth of the brick. This type eliminates the shrinking which is common in a sand cushion and at the same time eliminates the hollow crumbling noise

which is common with the sand cushion type of construction. It gives a more economic and scientific design in that it provides a stronger slab with the same material.

Brick pavements with cement-sand beds were built in Baltimore as early as 1906 and adopted as their type of construction in 1915. The cement-sand bed was used in Jacksonville in 1910 and also in connection with the paving of the ramps of the Pennsylvania Railroad terminal in New York in 1910. It has been demonstrated here that shallow vitrified brick will stand up under heavy truck conditions when laid upon a cement-sand bed. In this case fire clay brick 2¼ inches in depth were used. This work in the Pennsylvania terminal demonstrates that in many places a block of less depth than the standard block can be economically used; in fact, in the city of Syracuse an experiment was made by which a 3½-inch block was laid on a cement-sand cushion with railroad tracks in the center on a street entering the city and satisfactory results have been obtained, and I have in mind that in the next pavement of this kind that we lay a three-inch brick will be specified.

BRICK PAVEMENTS WITH GREEN CONCRETE FOUNDATIONS.

This type of construction is commonly known as the monolithic type and is better adapted for highway construction up to, say, 24 feet in width or where a template may be used to shape the entire width of road at one time. It was first used in highway construction near Paris, Illinois. Proper consistency of the concrete foundation is essential for this type of construction. Care should be used in the proper spading and distributing of the concrete to prevent waves in the finished pavement due to possible difference in density. The concrete foundation is spread usually ½ inch high and formed by using a tamping template which brings to the top a smooth mortar surface on which to bed the brick.

For this purpose there has been developed a mechanical templet which consists of a gasoline engine mounted on a cross frame with wheels, which is carried on the side forms. This power templet performs the double purpose of tamping and smoothing the concrete, and in addition compresses it to better density. This templet moves at the rate of 4 feet a minute and can be adjusted to different widths. The laying of the brick wearing surface should follow closely on the concrete foundation and the bricks should be inspected, culled and rolled before the cement has taken its initial set. For rolling the wearing surface, a hand roller is advocated about 30 inches long, 24 inches in diameter, weighing from 600 to 900 pounds. The rolling should follow immediately after the inspection, so that the grout filler may be applied at once to secure the necessary bond with the concrete foundation.

In this connection the so-called wire-cut lug brick is of special value in that it develops the full strength of the slab by reason of its superior side bond, due to its fiber sides, and assures penetration of the bonding material to all parts of the joints due to its uniform lugs.

The mixing and placing of the grout filler is of the utmost importance for this type of construction, as in the construction of brick pavements of the other types, and the same precautions must be taken in the selection of the materials and their application.

All the advantages claimed for the semi-monolithic type of construction will hold for the brick pavements constructed on green foundations, to which may be added the increase of slab strength due to the more perfect bond of the wearing surface and the concrete foundation. This type also eliminates the use of edges in highway construction. which reduces the cost. The use of the semi-monolithic and monolithic types have tended to develop the use of paving brick of less thickness, which will result in economies, one of the most important being the saving in transportation charges. There should also be an economy in the first cost together with a saving in actual manipulation.

In my opinion the day of the sand cushion on rigid foundation is ended and the satisfactory type is a cement-sand cushion for village and city streets, while brick pavements for highways should be constructed on a green concrete foundation.

In closing I wish to emphasize the paramount importance of proper design of highways to take care of modern traffic. To my mind a rigid foundation is absolutely necessary on main trunk lines and where truck traffic predominates or may develop in the near future. The use of motor trucks for commercial purposes has grown tremendously and it is our duty to design highways which will be able to stand their loads up to reasonable limits and with reasonable maintenance charges.

FINANCING HIGHWAY IMPROVEMENTS*

Life of a Loan Should Be That of the Road—Payment by Annual Appropriations—Parties Interested in Road Financing.

The subject of "Methods of Financing Highway Improvements for States, Counties and Townships" has been frequently discussed in papers presented at meetings of this association and in the technical press.

Your committee appointed to consider this subject will present what it believes to be some fundamental principles which should control the policy to be followed in the raising of funds for highway improvement, especially where these funds are raised by loans. Consideration will be given only to road systems outside of populous centers, in which latter the property values are large and the policy of assessment for benefit quite generally prevails. It will deal, therefore, with the method of raising funds where the cost of the improvement is to be a general charge.

J. E. Pennybacker, chief of management of the Bureau of Public Roads of the U. S. Department of Agriculture and who is also a member of this committee, has prepared a memorandum of the methods which have been used in financing highway improvements, which covers the ground very fully, which memorandum the committee submits herewith and makes it a part of its report.

It is very desirable that a complete system of roads should be developed as quickly as possible in order that the public may have the benefit of it. If the project is one which can be entirely carried out in, say, five or six years, the raising of funds by direct taxation through annual appropriations would involve an undue burden and the logical way to provide them is by a loan, but this loan should be for a period no greater than the probable average life of the improvement. Part of the work may be of a permanent character, such as the improvement of lines and grades; part may have an estimated life of thirty or even fifty years, such as bridges, culverts and tree planting; while the road surface may not last more than ten or fifteen years. There may be

*Report of Committee on "Methods of Financing Highwar Improvements for States, Counties and Townships" of the American Road Builders' Association, Nelson P. Lewis, chairman, presented at the sixteenth annual convention.

a term of years which may be said to correspond with the average life of the entire improvement and this should be the limit of the term of the loan. Whether all of the bonds should run for the same length of time and a sinking fund established to care for them at maturity or whether they should be serial bonds—and both plans have their advocates—the debt should be paid within the estimated average life of the improvement taken as a whole.

If, however, the project involves a state-wide improvement which could not be completely carried out in twenty years or more, it would be cheaper in the end to provide for it by annual appropriations, the burden of which would be no greater than would the interest and the sinking fund payments on long-term or fifty-year bonds. This plan involves one serious difficulty in that the completion of the project will depend upon the caprice of the law-making and appropriating body. With a bond issue authorized and the bonds sold, there is no question as to the funds and the work can be organized and carried out in an orderly and efficient manner. To create an organization to perform the work and to get it well under way in the expectation that the necessary annual appropriations will be made, and then to have them stopped as a result of financial stringencies, or a change in the complexion of the appropriating body and a desire on its part to investigate what the party formerly in control had done, would be disastrous.

In order to avoid such a contingency, it will probably be better, even in the case of road improvements which would require a number of years to carry out, to resort to the issue of bonds so arranged with respect to maturity that the tax burden to provide for their liquidation would correspond quite closely with an annual appropriation covering what might reasonably be considered the life of the improvement. Such methods have been quite frequently adopted or proposed during recent years, an excellent example being that suggested by the financing of the $60,000,000 road improvement scheme in Illinois. This Illinois plan appears to contemplate caring for the bonds, as to both principle and interest, from receipts for the licensing of motor cars. Such use of these bonds may be justified, but this source of revenue should be devoted first to maintenance and only the surplusage over these requirements should be used to liquidate a debt incurred for construction.

Your committee will not multiply examples, but will urge upon those responsible for the planning and financing of future highway improvements, especially those the cost of which is to be met by loans and the magnitude of which will be very great, the necessity of the adoption of such sound methods of financing as will commend themselves to all of the following parties in interest:

The taxpayer, who wants value received for the funds which the town, county or state takes from him and does not wish to keep on paying for something which is worn out and forgotten;

The contractor, who wants the work of highway improvement to go on in an orderly fashion and in such a way that the public authorities will not be obliged to stop this kind of work until popular discontent at the manner of financing which may have been adopted has had time to blow over;

The town, county or state, which desires to preserve its credit and find a ready market for its obligations when issued;

The investing public, which likes to feel that funds available for investment can be safely loaned to the government which stands in the most intimate relation to them; and to

The politician, who is always ambitious to acquire a reputation for shrewdness and sound judgment in his conduct of the public business.

HAY-TAR ROADS IN WISCONSIN.

Some months ago Municipal Journal described an experiment being made by the Wisconsin Highway Commission, consisting of the application of hay and tar to roads in deep sand in a section of country where other materials were not available. In part of the experimental road, marsh hay and tar were used, while on the balance marsh hay or rye straw was used covered with a thin layer of sand.

After twelve months of service, the State Highway Commission reported that the untreated hay had been destroyed, largely by rotting. Untreated hay with sand on it enabled the treated layer to be placed much more uniformly and without the formation of ruts, but the first layer of hay was not of lasting benefit. However, it was demonstrated that the mere adding of sand to an untreated application of hay or straw increased its life greatly. In a number of sections of that state, and elsewhere, roads have been treated by merely placing hay upon them, whereas their life could be easily doubled by placing sand on top of the hay.

It was apparent that the method of employing the tar was not satisfactory, since running the oil-spreading wagon over the layer of hay formed ruts in the sand beneath, which could not be removed. If this type of road is to be constructed, some better method of distributing the tar should be devised. (We suggest a caterpillar truck for distributing the tar.) If such a road is to be maintained through a series of years, less hay and tar can be used during the second and following years than on the first application.

The commission was surprised to find that the rye straw proved as satisfactory as the hay, but this was apparently the case.

The cost of the experimental road was $701 for 4,977 square yards which were treated with tar to the extent of from a half-gallon to a little over a gallon per square yard, and 1,900 square yards which did not receive any tar treatment.

The commission does not recommend this type of road where it is possible to obtain local clay or gravel. At the present time a mile of nine-foot road treated in the best manner above described would cost about $1,000 and higher. This might be justifiable if no other material can be obtained, but the commission feels that the same money could be used more economically in placing clay or gravel if this material were available within a distance of several miles. Also it probably would not prove at all satisfactory for roads carrying any considerable amount of heavy truck or wagon traffic.

A HAY-TAR ROAD IN THE MAKING.
Tar distributor has just passed.

The WEEK'S NEWS

Reorganization of U. S. Defense Council's Highway Transport Committee—California's Highway Developments—Indianapolis Begins Work on $2,000,000 Sewage Plant—Suppressing Drug Traffic in New York City—Auburn, N. Y., Increases Water Rates—Eight-Hour Day for Ft. Wayne Police—Ranger, Oil Town, Swept by Fire—Court Declares Municipal Ice-Making Unconstitutional—Los Angeles to Sell Municipal Cement Mill.

ROADS AND PAVEMENTS

May Reimburse War-Hit Contractors.

Albany, N. Y.—The sum of $3,500,000 would be appropriated to reimburse highway contractors who abandoned their contracts because of the high war cost of labor, materials and transportation under the terms of a bill introduced by senator Knight. The measure would give contractors who abandoned work in 1917, not to exceed 35 per cent. above the original contract price and those who abandoned their contracts in 1918 not more than 45 per cent. The final determination of the awards is to be left to the Court of Claims. The contractors would be permitted to receive the percentage of excess upon their stipulation that the amounts represented no profit to them.

Highways Transport Committee Reorganized.

Washington, D. C.—Grosvenor B. Clarkson, director of the U. S. Council of National Defense, announces a reorganization of the council's Highways Transport Committee. In harmony with the council's reorganization to a peace-time basis, the work of the Highways Transport Committee has been broadened to include direct representation from the office of Public Roads and Rural Engineering of the Department of Agriculture; the Bureau of Markets of the same department; the Postoffice Department and the Department of Commerce. With this reorganization close co-operation with the executive departments most vitally interested in matters of highways transportation will be brought about in such a way that the committee will be clearing house of action for all federal interests concerned. The committee as reorganized consists of the following: John S. Cravens, of the Council of National Defense, chairman; James I. Blakslee, fourth assistant Postmaster General; J. M. Goodell, consulting engineer, office of Public Roads and Rural Engineering; James H. Collins, investigator in market survey, Bureau of Markets; R. S. MacElwee, second assistant chief, Bureau Foreign and Domestic Commerce; Charles W. Reid, executive secretary, and Grosvenor B. Clarkson, director of the council, ex-officio. The committee will be assisted by the Highways Transport Committee Advisory Board consisting of: William Phelps Eno, of Washington, D. C.; Prof. Arthur H. Blanchard, of New York; C. A. Musselman, of Philadelphia; Raymond Beck, of Akron, Ohio, and John T. Stockton, of Chicago. The council in addressing itself particularly to the problems growing out of the entrance of the motor truck into the commercial transportation field, will seek to determine just how the motor truck can best be fitted into the nation's existing transportation agencies. It is the policy of the council, through its committee, to co-operate with all transportation agencies with the view of determining for the people how their transportation needs can be served most efficiently, speedily and economically, and to aid in the promotion of motor express lines through rural communities which now do not have adequate transportation. The council will co-operate with the United States Railroad Administration in the study of the short haul problem, and will also give specialized attention to the relation of the rural motor express to interurban electric lines and waterways traffic in the interest of all elements concerned. John S. Cravens, who heads the committee, is from California, and is a banker and electric power developer of wide experience and high standing, who has served with the council for nearly two years. The eleven regional directors of the Highways Transport Committee are leading business men in their respective localities, and distinctly represent general business rather than any form of transportation interests.

Highway Progress in California.

Sacramento, Cal.—At the end of the fiscal year last July there were 2,300 miles of highway in California under state maintenance, according to the first biennial report of the state highway commission just issued. The estimated cost of seven proposed laterals is given as $9,000,000, of which the counties' share would be about $6,000,000. Some of the counties, it was stated, cannot afford the amount to be assessed against them, and the report gives, as the view of the commission, that it "sees no reason why the roads should not be constructed and paid for by the state as are other roads in the system. In general they are of much greater importance to the state at large than are some of the laterals in county seats provided for in the first State Highway Act, providing for work for which $18,000,000 in bonds was issued." For the biennial period ending June 30, 1918, there were built 1,617.14 miles of state highway. These figures do not include contracts concluded but not yet accepted, aggregating 349.37 miles. During the war period, the report says, highway work dragged, and the cost was increased from 40 to 60 per cent. over the estimates for 1915. The result was that contractors lost money, and it is recommended in the report that these losses should be the subject of special consideration. A bill is now before the Legislature authorizing the commission to reimburse these losses. Of the second issue of bonds there remains unsold approximately $7,884,000 worth, of which $3,000,000 must be reserved for the construction of laterals, and obligations already incurred will require at least $2,750,000 for their fulfillment, so that little more than $3,000,000 remains for new work. Untoward conditions due to the world war upset the expectations of the commission to complete the state highway system with the proceeds of the second bond issue of $15,000,000. No recommendation was made by the commission as to the proposed new bond issue, but it was declared that the "commission is faced with the only other alternative of securing the greatest value attainable with the funds at its command." The report contains a recommendation that a state motor police be established to stop the abuse of state highways by heavily loaded trucks and other agencies. It is suggested that the police be limited in number and authority and be under the jurisdiction of the motor vehicle department.

SEWERAGE AND SANITATION

Begin Work on $2,000,000 Sewage Plant.

Indianapolis, Ind.—The board of sanitary commissioners, which will build the $2,000,000 sewage disposal plant for the city of Indianapolis, has employed Charles H. Hurd, consulting engineer, as supervising engineer of construction. The work, it is estimated, will require from two to three years to complete. Mr. Hurd, who resigned recently from the board of sanitary commissioners, having been ap-

pointed in 1917 after the legislature had passed the law providing for the sanitary board and the erection of the sewage disposal plant, will receive a salary of $15,000 a year. The board adopted a resolution that all appointments of employes provided for in the contract with Mr. Hurd shall be made by the board on recommendation of Mr. Hurd, the board reserving the right to reject any nomination. The board also reserved the right to dismiss any employe, for cause, on its own motion. Under Mr. Hurd's contract, he will prepare the designs for the plant, supervise construction, prepare bids for submission to the board by contractors and when received tabulate them for the board and keep the board advised daily as to the progress of the work. The sanitary commission, composed of Frank C. Lingenfelter, president; Lucius B. Swift, vice-president, and Jay A. Craven, secretary, decided, after getting tentative proposals from engineering firms qualified to handle the project, that it would be much more economical and more advantageous for the city to have a supervising engineer who would be on the job practically constantly. Proposals were obtained from two of the leading engineering firms of the east, and the fees asked for the preparation of detailed plans and supervision of the construction work through resident engineers averaged approximately $130,000. If the engineering work had been taken over by an engineering firm such as those which submitted proposals, the commission points out, the construction work would have had to be taken over by a general contractor whose fee would range from 8 to 10 per cent of the contract price, or from $160,000 to $200,000. Under the plan adopted by the board the construction work will be supervised by Mr. Hurd, and the board and the general contractor's fee will be saved. The board will employ and pay necessary assistant engineers. The construction of the huge intercepter, which will carry the city's sewage from the sewers to the sewage disposal plant, which will be built on city property southwest of the city, will be begun first and the board is obtaining the right of way for the intercepter.

City Opens Clinic for Drug Addicts.

New York, N. Y.—Following extensive raids against druggists and physicians who have been illegally writing and filling prescriptions for narcotics, the city health and police officials were besieged by requests for the drugs from addicts and a clinic has had to be opened for them. Using the broad powers conferred by the Harrison anti-narcotic law for the first time, the federal government struck heavily at the drug traffic, arresting six physicians and four druggists and herding more than 200 addicts, shaking, quivering, physical wrecks, not one of them more than thirty years old, into police headquarters. The raids came suddenly and were worked out and directed by Major Daniel L. Porter, supervising internal revenue agent for this district. The decision to attack the drug traffic in this city was reached some months ago, after many reports had gone to Washington indicating a steady increase in the illicit use of cocaine, heroin, morphine and other narcotic poisons; reports which were supported by the recent utterances of health commissioner Copeland warning that drugs were fast becoming a menace to the city. Although prepared to go ahead with the campaign, the agents of the bureau of internal revenue, going on their assumption that the mainstays of the traffic were unscrupulous physicians, were unable to take action because of the legal protections enjoyed by the profession. In the latter part of February, however, the United States Supreme Court rendered a decision which interpreted the Harrison law so as to give the enforcing officers almost limitless authority. Major Porter worked for some weeks at Washington, and then with a strong force of special agents—men from all professions and trades from lawyers and physicians to steamfitters and clerks—came to New York and made the raid after secret investigations. The agents in their two months' investigation in this city established that in the last year 1,500,000 prescriptions for the illicit procuring of narcotics had been issued and filled. It was also ascertained that the federal authorities have evidence that thirty physicians are in a sort of "drug ring" issuing prescriptions for narcotics for fees ranging from 25 cents to $4. The principal drug being dispensed in this city, according to the investigations of the federal agents, is heroin, a derivative of opium, and one of the most destructve narcotic poisons. This drug is obtained through the regular channels at $12 to $15 an ounce and is retailed through the prescriptions at $60 to $75 an ounce. The unscrupulous physicians writing the prescriptions are each issuing as many as 200 a day, the agents are prepared to prove, most of the doctors having no other practice. The investigations of the government in New York have disclosed that 70 per cent. of the drug addicts are less than twenty-five years old, and that included in the victims are a remarkably high percentage of discharged soldiers and sailors. Sixty or more drug addicts visited the drug addiction clinic the first day it was opened by the department of health, and during the day about seventy-five addicts applied for relief at the community clearing house for addicts. They were all sent to special wards in four hospitals. Hundreds came the second day.

WATER SUPPLY

To Protect Mains from Electrolysis.

Evansville, Ind.—An arrangement which will save the city hundreds of dollars has been made by the water works board in entering into an agreement with the Public Utilities company to eliminate electrolytic action which is injuring the water mains of the city. The board adopted the report of E. E. Brownell, of Philadelphia, consulting electrical engineer, who had made a survey of the electrolytic condition of the water service. The Public Utilities company already had agreed to carry out the recommendations in Mr. Brownell's report. A contract is to be signed by which the Public Utilities company will install a mitigating system by Nov. 1 and Mr. Brownell will make an inspection of it at that time. This system, which will be installed entirely at the expense of the Public Utilities company, under the direction of the joint engineer, will be a system of wires and cables which will hold the current which is now escaping through the ground and destroying the water mains, as well as the Public Utilities company's gas mains. In consideration of this action by the company, the city will waive all claims to damages to pipes. The new system will make certain that no damage will be done hereafter to the pipes, although, of course, pipes that have been damaged prior to its installation will still be liable to break under too much pressure. Mr. Brownell, who will have practically the status of an official of the city, will oversee the operation of the system and will inspect it at least once a year.

Water Rates Increased.

Auburn, N. Y.—The water board has adopted a new schedule of rates that amounts to an increase of approximately 30 per cent over the present flat rates and 15 per cent over the present metered rates. The high level of prices for labor and materials is the cause. The annual report of the board says: "As a large part of the expense for pumping water is the cost of coal it is interesting to note what the amounts have been for the past four years. They are as follows:

1915	$8,262.80
1916	9,099.26
1917	14,271.07
1918	20,132.08

"The above figures represent the rising cost of coal during the war period, but it does not represent the pumping of any large extra amounts of water, and it represents only the additional cost of coal; and as the cost of coal has gone up the quality of it has deteriorated to such an extent that the cost of it is seen to have increased nearly

250 per cent." The new rates went into effect April 1. Compared with the old ones they are as follows:

Annual Fixture or Flat Rates.

Faucet (or sink use)	$3.40	$2.60
1 water closet	2.60	2.00
Additional closets, each	1.40	1.00
1 bath tub	2.60	2.00
Additional bath, each	1.40	1.00
1 wash basin	.80	.60
Additional basins, each	.60	.40
1 set washtubs or trays	1.80	1.40
Hose use, when held in hands, season	4.20	3.20
Hose use, stationary, entire use in premises, will be metered.		
1 stable, private	4.20	3.20
1 hopper closet	7.80	6.00

(Above net rates are for one family only. A penalty of 10 per cent. will be added if not paid on or before the 20th of the first month in each quarter.)

Monthly Meter Rates per Meter.

Minimum rate, each meter	$0.65
First 1,000 cu. ft. (1)	1.30
Next 2,000 cu. ft. (3 inc.) each	1.00
Next 5,000 cu. ft (8 inc.) each	.80
Next 10,000 cu. ft. (18 inc.) each	.70
Next 20,000 ft. (38 inc.) each	.50
All over 38,000 ft., each	.40

(The above meter rates are net with a penalty of 10 per cent. added if not paid on or before 10th of current month.)

During the last few years operating expenses have increased rapidly, as is shown by the following table:

1915	$60,557.79
1916	67,866.71
1917	73,967.33
1918	82,004.49

FIRE AND POLICE

Eight-Hour Day for Police.

Ft. Wayne, Ind.—An eight-hour day for all city patrolmen has been ratified by the board of safety, the finance committee of the city council, a delegation of members of the police force and a committee from the Federation of Labor. The new eight-hour day will go into effect on October 1, 1919, provided the city council acts favorably on the ordinance, which is soon to be introduced asking for the appropriation of an additional $5,000, which, it is believed, will be sufficient to defray all expenses due to this change for the remainder of 1919. Fifteen new patrolmen will be required. The eight-hour day will only affect the patrolmen, but ways and means are being devised, it is thought, whereby all members of the poilce department will be benefited.

Big Blaze Sweeps Oil Boom Town.

Ranger, Tex.—Almost two square blocks of the business district of Ranger were wiped out by fire with a loss estimated at between $750,000 and $1,000,000. Before the flames had died away, owners of destroyed structures were planning to rebuild. Under provisions of a recently passed city ordinance, only fireproof buildings can be erected in these two blocks, as they are in the fire district—in the very heart of Ranger. Several of the largest restaurants of Ranger were burned to the ground. The district that was destroyed consisted mostly of frame buildings erected quickly to take care of the constantly increasing abnormal population attracted to Ranger by oil. The buildings, some of which had only board walls, burned fast. For a few minutes it looked as if the entire business part of Ranger would be burned to the ground. A change of wind, together with the bucket brigade's fighting, however, prevented the flames from extending farther than they did. Oil drillers, proprietors and employes of the burning establishments, women and children, joined in the bucket brigade fight. Water was scarce, and had it not been for the recent rains the fire fighters would have had an even more difficult task. Nearby tanks had been filled by the heavy rains. There was only one hydrant with running water in the vicinity of the fire. Ranger's bucket brigade, organized before the real oil boom came, was not able to meet the situation. Business men of Ranger had been fearing the fire and realized that if a fire should ever get under way it would wipe out at least a block. They had already started a movement to secure adequate fire fighting apparatus. The need of such equipment was one of the reasons Ranger was recently incorporated. Some of the smaller buildings were dragged from their locations with the hopes of saving them. Chains were tied around them and they were pulled aside by auto trucks only to be eaten up by the flames a few minutes later. Nearly all Ranger began to move when the fire started to spread. Thinly clad guests left their hotels and rooming houses. Fixtures were dismantled and placed in the street. A few home owners near the business districts moved their belongings in wagons to the edge of the town.

To Oust Police and Firemen Who Gave Low Age.

Hoboken, N. J.—Supreme Court Justice Francis J. Swayze has made an absolute rule permitting the Hoboken Chamber of Commerce to go ahead with the quo warranto proceedings to oust twenty-five police and firemen who swore falsely that they were under the thirty-five-year age limit at the time of their appointment. This means that the justice takes no cognizance of the fact that the men have formally resigned from the police and fire departments. The court upholds the contention of Dougal Herr, counsel for the chamber, that the policemen and fire fighters cannot resign from positions that were never lawfully theirs. Action will be taken later upon the application of Mr. Herr to punish them for perjury and misrepresentation. The men in question resigned just before the case began before justice Swayze. Mayor Griffin and the city commissioners will reappoint them after extending the age limit to fifty-five years. City attorney John J. Fallon apparently thought that the suit would be discontinued when he made this announcement. But Mr. Herr proceeded to ask justice Swayze to punish the men for perjury and misrepresentation. This application made it necessary to take all the testimony. Registry books from the county clerk's office were produced to show that the appointees were over thirty-five years of age. At the conclusion of the hearing justice Swayze took the matter under advisement. The justice said he doubted that his powers included the right to punish individuals for perjury in such cases. His immediate opinion was that a man cannot be punished for perjury unless the grand jury has found an indictment for offense.

MISCELLANEOUS

Municipal Ice-Making Unconstitutional.

Kansas City, Mo.—The $400,000 bond issue proposed for the purpose of constructing a municipal ice plant for the city, has been declared unconstitutional by the Supreme Court of the state on the ground that ice-making is a private enterprise and the city cannot engage in private enterprises. The decision was six to one. The dissenting judge held that ice is a prime necessity in cities and its manufacture for the protection of the health of the people is an exercise of the police power. There may be an application for a rehearing.

To Sell Los Angeles Municipal Cement Plant.

Los Angeles, Cal.—The city is now advertising for buyers of its big cement plant, said to be the only municipal portland cement mill ever existing. The Monolith mill was built in 1908 by the city for the manufacture of cement to be used in the large Los Angeles aqueduct project. The plant is situated 117 miles north of Los Angeles, and includes contiguous and almost inexhaustible deposits of clay and limestone. The city was for a time undecided as to its disposition, but has finally determined not to enter into commercial competition in the production of cement and that the mill is much too large for the needs of its own construction. The mill used a volcanic deposit in close proximity to the mill, producing a tufa cement. This blended cement required additions to the mill, so that now it has a capacity for blended cement of about 1,500 barrels.

NEWS OF THE SOCIETIES

April 25-26.—AMERICAN ACADEMY OF POLITICAL AND SOCIAL SCIENCE. Annual meeting, Philadelphia, Pa. Secretary, J. P. Lichtenberger, Logan Hall, West Philadelphia, Pa.

May 6-8.—NATIONAL FIRE PROTECTION ASSOCIATION. Annual convention, Ottawa, Can. Secretary, Franklin H. Wentworth, 87 Milk St., Boston, Mass.

May 13-14—AMERICAN ASSOCIATION OF ENGINEERS. Annual meeting, Chicago, Ill. Secretary, C. E. Drayer, 29 South LaSalle St., Chicago, Ill.

May 14-15.—LEAGUE OF TEXAS MUNICIPALITIES. Seventh annual convention, Sweetwater, Tex. Secretary-treasurer, Frank M. Stewart, University of Texas, Austin, Tex.

May 19-24.—NATIONAL ELECTRIC LIGHT ASSOCIATION. Annual convention, Atlantic City, N. J. Secretary, T. C. Martin, 29 W. 39th St., New York.

June 9-13.—AMERICAN WATER WORKS ASSOCIATION. Thirty-ninth annual convention, Iroquois Hotel, Buffalo, N. Y. Secretary, J. M. Diven, 47 State street, Troy, N. Y.

June 17-20.—AMERICAN SOCIETY OF CIVIL ENGINEERS. Annual meeting, St. Paul-Minneapolis. Secretary, Charles W. Hunt, 33 W. 39th St., New York, N. Y.

June 23-26. — SOUTHWESTERN WATER WORKS ASSOCIATION. Annual convention, Coates House, Kansas City, Mo. Secretary, E. L. Fulkerson, 617 Washington St., Waco, Tex.

June 24-27. — AMERICAN SOCIETY FOR TESTING MATERIALS. Twenty-second annual meeting, Hotel Traymore, Atlantic City, N. J. Secretary, University.

June 24-27.—INTERNATIONAL ASSOCIATION OF FIRE ENGINEERS. Annual convention, Kansas City, Mo. Secretary, Gen. Fire Marshal James McFall, Emergency Fleet Corporation, U. S. Shipping Board, Philadelphia, Pa.

Nov. 12-14.—AMERICAN SOCIETY FOR MUNICIPAL IMPROVEMENTS. Annual convention, New Orleans, La. Secretary, Charles C. Brown, Bloomington, Ill.

American Society for Testing Materials.

The American Society for Testing Materials will hold its twenty-second annual meeting at Atlantic City, N. J., on June 24-27, with headquarters at the Hotel Traymore. A number of committees will recommend new standards for publication as tentative, and reports will be made on several important investigations which have been conducted by committees. The present membership of the society is 2,372 as compared with 2,261 at the last annual meeting.

The society is participating with other engineering organizations in the work of the American Engineering Standards Committee, which was organized in October, 1918. Two A. S. T. M. standards — namely, those for Portland cement and those covering fire tests of materials and construction — have already been adopted by the standards committee as "tentative standards," with a view finally to their adoption as American standards.

On the invitation of the United Engineering Society the American Society for Testing Materials has become a member of the Engineering Council, in which there are now five other member societies, and has designated Albert Ladd Colby, South Bethlehem, Pa., as its representative in the council.

Engineering Council.

The Engineering Council, through its National Service Committee, has sent out invitations to 152 representative engineering societies of the United States, requesting the selection of delegates to attend a national conference on the establishment of a federal department of public works. The conference is to be held in Chicago April 23-25.

With the invitation there has been sent to each society a general plan of organization for the conference and a statement of some of the principal questions which the conference will have to consider. It is requested that the societies take up these questions and, if they so desire, vote upon them prior to the conference.

The calling of this conference follows close on the action of the Engineering Council on February 20, 1919, advocating the establishment by Congress of a department of public works and urging engineers in all branches of the profession to use their influence to arouse public opinion so that the importance to the national welfare of such a department may be understood.

American Water-Works Association, Illinois Section.

The eleventh annual meeting of the Illinois Section of the American Water Works Association was held March 25 and 26 at Urbana. Most of the papers read dealt with technical subjects.

Milton F. Stein described the work of the testing station at Cleveland, Ohio, on water softening. The design of the chemical treatment process as dictated by the experimental work was brought out to indicate that local tests should precede design in most cases.

Several typhoid fever outbreaks in Moline, Ill., have occurred in the past two years. M. C. Sjoblom traced the cause to a bypass valve permitting unfiltered water to enter the clear well at a time when little or no chlorine was being applied.

Lieut. Everett Judson, of the United States Public Health Service, described in detail experiments on adonite, a fermenting sugar, to differentiate B. coli. Opinions expressed in discussion indicated that the test was not yet a safe one.

Crenothrix removal was discussed. After a trial of more than a year the Champaign & Urbana Water Co. still finds the use of 4.6 lb. of chlorine per 1,000,000 gal. is an effective agent in eliminating crenothrix from its ground water-supply, said F. C. Amsbary. W. F. Monfort, in reviewing work done on the problem in conjunction with O. A. Barnes, indicated that chloramine was a better reagent, but that the difficulties of its application and in preserving its stability made the chlorine more desirable so long as it continued to kill the crenothrix.

Minna E. Jewell has been making intensive studies of the Sangamon River, one of the most polluted streams of the state. According to her conclusions, biological tests are more practical than chemical or bacterial in determining the extent to which stream pollution may be permitted without the creation of a nuisance.

Experience with the new large-capacity 36-in. well at the University of Illinois was described by Prof. M. L. Enger. Unlike the smaller wells, its capacity per foot of draw-down has increased in two years from 19.5 to 21.5 gal. per minute. One of the older wells was reduced in 10 years from 7.2 to 4.9 gallons.

Consumption of water at Illinois state institutions varies from 70 to 350 gal. per capita per day, according to F. J. Postel. Meters are installed on the low-consumption systems. There has been wilful waste of water.

L. R. Howson, outlined the unusual well-water supply conditions of Baton Rouge, La., where 2050-ft. wells deliver water at a temperature of 92° F. with a static head of 120 ft.

The Old Hickory Powder Works water-supply was described by O. E. Bulkeley. Ninety-six tub gravity filters with a daily capacity of 65,000,000 gal. were hand-operated. Determination of the rate by noting the drop each hour, and the satisfactory utilization of women as filter attendants, were features of the operation.

The following officers were elected for the coming year: Chairman, W. E. Lautz; vice-chairman, F. C. Amsbary; treasurer, H. E. Keeler; secretary, G. C. Habemeyer, Urbana.

American Association of Engineers.

The Pittsburgh Chapter of the American Association of Engineers now has a full-time secretary. This is the first chapter outside of national headquarters at Chicago to have a secretary giving all of his time to the work of the association. F. E. N. Thatcher has been selected for the position and will have an office at 1312 Fulton building, Pittsburgh.

The Washington Chapter at its meeting elected the following officers: President, Harry Stevens, civil engineer, Union Trust Co. Bldg.; first vice-president, A. Y. Hess, designer, Navy Department; second vice-president, Clegge Thomas, mechanical engineer, Washington Loan and Trust Co. Bldg.; secretary, E. L. Howard, Bureau Yards & Docks, Navy Department; treasurer, O. M. Sutherland, mechanical engineer, Bureau Yards & Docks.

The Kansas City Club of the American Association of Engineers at its recent meeting elected the following officers: Chairman, J. E. Jacoby, consulting engineer, Shukert Bldg.; vice-chairman, W. B. Cast; secretary, R. N. Clark; treasurer, S. M. Bate.

INDUSTRIAL NEWS

Road Handbook.

The Barrett Company, New York, N. Y., has issued a valuable little handbook entitled "Tarvia Road Book." It contains useful tabulated data on highway construction quantities, including the amounts of Tarvia, stone, macadam, gravel, pitch filler or lug wood blocks, bricks, etc., on given road yardages under different conditions; weights of materials per cubic yard; table of ready computation of stone costs in road building; costs per mile at price per square yard; conversion tables of linear feet to miles and degrees F. to degrees C.; gauge of cylindrical tanks, specific gravities, degrees Baume, pounds per gallon and gallons per pound; instructions for applications of steam to B. M. X. tank car coils. There are also given complete specifications for Tarvia-B, Tarvia-A, Tarvia-filled macadam, resurfacing old macadam with Tarvia, Tarvia modern pavement, Tarvia mixed macadam and Tarvia concrete—Topeka mix. There are blank pages for memoranda. The handbook is conveniently and attractively bound in green leather. It is issued free upon application by any highway engineer, contractor or road builder.

"Prosperity Campaign" to Promote Construction.

In an effort to stabilize prices, lower the cost of living and stimulate business reconstruction a "National Prosperity Campaign" under the chairmanship of Philip H. Gadsden, Chairman of the National Public Utilities Committee, has been begun. The object will be to bring business men to the belief that it is within the power of industry to resuscitate itself. A statement issued says:

"That the stabilization of business at present price levels rests within the power of industry itself is the belief of the National Federation of Building Industries, and is the message that is being forwarded to members of the War Service Committees and the Chambers of Commerce of the United States, as well, as by leaders of business, by the National Prosperity Campaign.

"Regardless of Government attitudes toward the present price situation, there is a realization of the necessity for the upkeep of production and the absorption of the unemployed, and the distribution of such propaganda as will stimulate confidence as well as activity in business projects. Several hundred firms throughout the country have wired their approval and co-operation, the sponsors of the movement including Franklin T. Miller of the Department of Labor, John J. Arnold, Julius Rosenwald, Alexander C. Brown, Charles F. Lang, E. T. Trigg, E. P. Albrecht, Joseph E. Davies, Frank A. Sieberling, Cardinal Gibbons, James H. McGraw and others.

"Granting the general retail buying by the ultimate consumer is still enjoying its usual boom even at present prices, the fact remains that industry has been waiting, and is waiting for basic prices to strike a permanent level that would justify going ahead and still be protected against loss by a drop in prices. Present prices are here to stay, so far as price levels are concerned; we cannot await the industrial adjustment of the entire world. Factory fires must be kept burning and wheels turning, and labor must be employed at a scale of wages commensurate with the prices of commodities."

Appeals have been sent to the governors of the states and mayors of principal cities by the committees, requesting conferences with their business interests that are now awaiting building and highway construction.

PERSONALS

Worth, George, has been appointed chief engineer of the city water works of Waukegan, Ill.

Wuest, Charles Jr., formerly engineer of roads, United States Nitrate Plant No. 4, has been appointed office engineer, Division of Highways, Illinois Department of Public Works and Buildings, with headquarters in Springfield.

Carter, H. R., state highway engineer of Arkansas, has resigned to engage in private practice.

MacDonald, Thomas H., has been appointed engineer in charge of work under the Federal-aid road act by Secretary of Agriculture Houston. He is 37 years old and was educated as a civil engineer at the Iowa State College. After a short period in railroad work, he became, in 1904, assistant professor of civil engineering in charge of road investigations at Iowa State College. Since then he has been devoting himself to the highways of the state. The first legislation toward state supervision of road work in Iowa in 1906 placed this work under the supervision of the Iowa State College, and Mr. MacDonald became the executive officer at the beginning. As the work increased, an engineering as well as an administrative staff was placed under his direction, and when the Iowa Highway Commission was created as an independent body he was made the state highway engineer and its executive officer.

For some time he will concentrate on problems arising from the increased appropriations for federal aid. It is planned that in the near future he will formally assume the position of director of the Bureau of Public Roads, made vacant by the death of Logan Waller Page.

Mr. MacDonald has been very active in a number of highway organizations and has been prominent in the American Association of State Highway Officials.

Greene, Frederick Stuart, has been appointed state commissioner of highways of New York to succeed Edwin Duffey, the senate having confirmed Governor Smith's nomination. Attorney-General Newton has ruled that commissioner Duffey's term of office expired a year ago.

Fuller, Royal K., has been appointed secretary of the state commission of highways of New York.

U. S. CIVIL SERVICE.

The United States Civil Service Commission announces open competitive examinations on May 29 for the positions listed below. Vacancies in the Bureau of Public Roads, Department of Agriculture, at the salaries indicated and in positions requiring similar qualifications at these or higher or lower entrance salaries, will be filled from these examinations. The entrance salary within the range stated will depend upon the qualifications of the appointee and the duty to which he is assigned. Competitors will not be required to report for examination at any place, but will be rated on general education (relative weight, 20), and technical education, experience and fitness (relative weight, 80). The compensation and duties of these positions and minimum requirements for eligibility for appointment are as follows:

Chief of Road Survey Party ($1,800-$2,100).

Duties—Management of parties making surveys for road work, preparation of plans and estimates for highway construction, and management of camps for such work. Requirements—At least four years' preliminary civil engineering experience or graduation from course in civil engineering, and, in addition, at least two years' experience as chief of survey party engaged on highway or railroad work or else one year's experience as chief of such party and two years' experience as instrument man in such party. Age—25 to 55.

Transitman for Road Surveys ($1,200-$1,800).

Duties—Direction of transit section of survey party, keeping notes, making computations and drawing based on field notes, and such other duties as assigned. Requirements—Graduation from civil engineering course or at least three years' preliminary civil engineering experience, and, in addition, at least one year's experience as transitman on surveys made with same degree of accuracy required on highway and railroad surveys. Age—22 to 55.

Highway Draftsman ($1,200-$1,800).

Duties—Plotting notes, drafting, tracing, and computing quantities. Requirements—At least two years of civil engineering course, including instruction in engineering drafting, graduation from standard high school or course of study equivalent to that required for such graduation, and at least two years' drafting experience in civil engineering office. Each applicant must submit tracing of drawing to be furnished him by Commission, accompanied by statement under oath that tracing was made and lettered entirely by applicant in stated time. Tracing will be given consideration in rating subject of technical education, experience and fitness. Age—20 to 55.

The Commission announces examinations for positions listed below on May 21. The duties of appointees will consist of making surveys of bridge sites, the design and preparation of plans for highway bridges, the superintendence of their construction, and their inspection. Competitors will be examined in following subjects: 1, Practical questions in highway bridge engineering (relative weight, 60), and 2, Education, experience and fitness (relative weight, 40).

Highway Bridge Engineer ($1,800-$2,100).

Requirements—At least five years preliminary engineering experience, successful completion of each year of engineering course being accepted as equivalent to 15 months of such experience; in addition, at least three years' experience in bridge engineering, of which at least one year must have been in highway bridge engineering. Age—21 to 40.

Junior Highway Bridge Engineer ($1,200-$1,600).

Requirements—At least four years preliminary engineering experience, successful completion of each year of engineering course being accepted as equivalent to one year of such experience. Age—20 to 30.

Applicants should at once apply for Form 1312, stating the title of the examination desired, to the Civil Service Commission, Washington, D. C.

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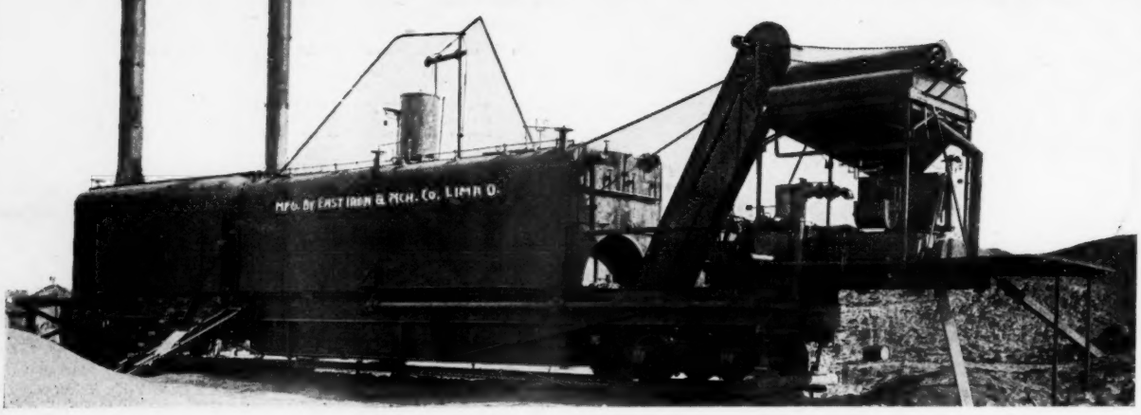

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The new one-car railroad plant measures only 55 feet over all. It is shorter than any other complete R. R. plant; weighs less, and costs less to transport.

Operating expense is lower than any other plant of near the capacity. Can be dismantled for shipment, or set up for operation in half a day.

Other new features are: Increased capacity of hot-sand bin; increased mixer capacity; higher power engines; each unit can be operated separately.

Our descriptive folder contains many expressions of satisfaction from users throughout the North American Continent. They tell more than we can say.

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LIMA, OHIO, U. S. A.

The Pioneer Manufacturers of Steam Melting Asphalt Plants